INTEGRATED EDITION OF THE PETROLEUM ENGINEER

FEBRUARY 1958

ONE DOLLAR FIFTY CENTS A COPY

the Petroleum Engineer

FOR MANAGEMENT

At 10 he went to work as a messenger boy for the company he now heads *A-8*

COLOMBIA

AREA OF PROMISE

New Look in Overseas Plants ..... SEE PAGE C-7

An Engineer Goes Abroad ..... SEE PAGE B-58

Colombian Pipelines Expanding ..... SEE PAGE D-20

Dowell Guide to Acidizing . . .

1 DEVONIAN

Lea County, New Mexico

Vugular formation usually below 12,000 feet. Common treatment is 500 gals. Mud Acid, followed by 3000 gals. acid with Dowell wetting and emulsion control agents. Results: wells often potential from 1500 to 1800 bopd.

2 MADISON

Williams County, North Dakota

Highly fractured vugular limestone of low porosity. Permeability seldom over two millidarcys. 90 to 92 per cent soluble. Usual treatment: Acid Petrofrac® — 250 gals. fluid per foot. Results: wells often test 200 to 1000 bopd.

3 D-1

Lac St. Anne Area, Alberta, Canada

Tight dolomitic formation. Responds well to Mud Acid wash, followed by 2000 to 4000 gals. Dowell acid with agents to control silicate swelling and emulsion. Results vary but generally considered profitable by the operator.

4 ELLENBURGER

Andrews County, Texas

Usually below 13,000 feet. Often needs only 500 to 1000 gals. Mud Acid. Where further stimulation is needed, 5000 to 20,000 gals. Dowell X Acid with silicate control and anti-emulsifying agents is used to good effect.

5 McCLOSKY

Clay County, Illinois

Oolitic limestone formation, 12 to 30 feet thick at about 3000 feet. Responds well to 5000 gals. Dowell acid containing surface tension reducing agent and a non-emulsifying agent. Results: wells often produce 240 bopd after acidizing.

6 RODESSA

Cass County, East Texas

Oolitic limestone at about 6000 feet. Usual treatment: 1000 gals. Dowell acid with wetting agent. Then 2000 gals. Channeling Acid and 10,000 gals. Dowell acid with wetting agent. Results: wells often test over 700 bopd.

These are just six examples of Dowell acid treatments that are being used successfully under widely varying conditions. Whatever *your* well conditions, call Dowell for dependable, profitable stimulation treatments. Dowell Incorporated, Tulsa 1, Oklahoma.

Services for the oil industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

FOR THE BIG JOBS

in petroleum financing

In the services of one of the nation's finest Oil Departments, in the strength of the largest capital structure and total resources in southern banking . . . here is the capacity to serve the business of oil financing — however small, however large!

IT PAYS TO BANK AT

REPUBLIC National BANK of Dallas

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

CAPITAL FUNDS OVER $90,000,000 • LARGEST IN THE SOUTH

A Magazine of Petroleum Management

the Petroleum Engineer

FOR MANAGEMENT

NUMBER 2 • VOLUME XXX • FEBRUARY, 1958

The Conference Table A-11

It looks like war — not of bloodshed — but of accomplishment.
Dr. J. Allen Hynek

Why Colombia Attracts Oil Companies A-24

New laws act as stimulus . . . Nation respects private enterprise . . . Petroleum companies train employees and award scholarships . . . Department of Conservation of Oil and Gas set up to investigate methods and determine best practices . . . Consumption has increased about 8 percent a year . . . Domestic refineries now meet demand.
— An interview with Dr. Julio Cesar Turbay Ayala, Minister of Mines and Petroleum

Fortune Beckons from Colombia A-26

There are hints and glimpses of earth's fair treasure in the lands of New Granada. Its coffee and emeralds top the markets of the world. Its petroleum in recent years has served the nation with energy and dollars. *— Ernestine Adams*

E SECTION FOLLOWS A

Want to Seek Oil in Colombia? E-3

These are the things to calculate before you search for reserves in South America . . . So far Colombia is behind on reserves . . . The big bonanza may be there but it will take capital to unearth the oil and get it to market. *— E. Ospina-Racines*

DRILLING AND PRODUCING

Colombia's Geological Features B-21
W. C. Hatfield

Oil Exploration in Northern Colombia B-26
C. R. Goss

Geophysical Parties — No Picnic in Colombia B-30

Waterflooding Gets a Try at La Cira B-32
Horacio Rodriguez

River Installations Protected by Dutch Brush Mattresses B-36
C. B. Roach

Drilling in Colombia B-42

Joe B. Woods
President and Publisher
Abbott Sparks
Vice President and Advertising Director
Frank H. Love
Vice President and Editorial Director
L. H. Johnston
Secretary-Treasurer

•

Ernestine Adams
Management Editor
J. E. Kastrop
Editor, The Petroleum Engineer, Drilling and Producing
S. W. Downer, III
Editor, The Refining Engineer
Frank H. Love
Editor, The Pipeline Engineer
Dean Hale
Technical Editor
C. R. Graham
Assistant Editor, Drilling and Producing
Lowell A. Murphy
Field Editor
Donald M. Taylor
Editor, Gulf Coast, JAckson 6-2631
2370 Rice Blvd., Room 110, Houston, Texas
Charles E. Gibson
Assistant Editor, The Refining Engineer
Arch L. Foster
Consulting Editor, The Refining Engineer
Jan Craig
Editorial Production Manager
Lynn Patton
Editorial Assistant
Nella McGranahan
Editorial Assistant
Donald D. Fickert
Presentation Editor

•

NEW YORK — **John Wallace**
Clyde Dillehay
52 Vanderbilt Ave., MUrray Hill 6-7232
CHICAGO — **E. V. Perkins**
John McDonald
53 West Jackson Blvd., HArrison 7-6883
LOS ANGELES — **Richard P. McKey**
465 East Union, Pasadena, RYan 1-0685
PITTSBURGH — **Art Gilliam**
4525 McKnight Rd., WEllington 1-0619
HOUSTON — **Jess Adkins**
J. B. Forse
2370 Rice Blvd., Room 110, JAckson 6-2631
DALLAS — **Ed Sealey**
800 Davis Building, Riverside 8-4403
BIRMINGHAM — **Fred W. Smith**
1201 Forest View Lane, Vesthaven TRemont 1-5762

•

Allen K. Tvler
Advertising Service Manager
Charles McKean
Circulation Director
Reval Courtney
Circulation Fulfillment Manager
Sherwood R. Entwistle
Circulation Promotion Manager
Morris Hodges
Production Manager
Cybee Goodrich
Assistant Production Manager

Copyright 1958
The Petroleum Engineer Publishing Company
Indexed by Industrial Arts Index and The Engineering Index, Inc.
Member of Audit Bureau of Circulation and Associated Business Papers

The Petroleum Engineer for Management, published monthly, August through June, semi-monthly in July, by The Petroleum Engineer Publishing Company, 800 Davis Building, Dallas 2, Texas. Cable address: PEPUB. Subscription rate to the Petroleum Industry, United States, Canada, and Foreign, $8.00 per year; $14.00 for 2 years; $18.00 for 3 years; $1.50 for single copy. Entered as second-class mail matter May 1, 1932, at the post office in Dallas, Texas, under the act of March 3, 1879.

Hydraulic System Solves Galan Pumping Problems B-44
William A. Gaviria
You Can Buy It in Colombia B-51
Development Problems on Colpet's Cicuco Concession B-53
Clyde F. Dawson
An Engineer Goes Abroad B-58
Intercol Tries New Approach With Personnel B-62
Surface Gamma Ray Logging of Subsurface Cores B-64
R. E. Jenkins and Marc C. Meurer
Shell's Giant Central Terminal Facilities B-74
J. E. Kastrop
What's Ahead in High Strength Tubular Goods B-95
A. B. Wilder
Canada Views More Exploration, Less Production in 1957 . . . . . B-106

REFINING AND PETROCHEMICAL

Cartagena Refinery: New Look in Overseas Plants C-7
Jon H. Baumgartner and Antonio Donado
Coke Calciner Onstream at Conoco Refinery C-10
L. E. Adee
Limitations to Great Expectations C-11
Creighton C. Carmine
Petrochemicals via the Oxo Process — Part I C-16
Peter W. Sherwood
Preventing Discoloration of Catalytic Furnace Oil C-19
K. A. Buchanan, R. H. Bruggink, and C. D. Lowry, Jr.
Premium Gasoline Up 1.1 RON in 1957 . . . . . C-22
Refinery Economics in the Penn Grade Crude Area C-23
John J. Schanz, Jr., and Robert C. Barwick
Esso Reduces Manpower at Bayonne Refinery C-26
The Refining Engineer's Continuous Tables C-28
How to Design Finned Tube Partial Condensers — Part IV C-37
Edwin H. Young and Dennis J. Ward
Plastics in Refining and Petrochemicals Plants C-46
Dr. Raymond B. Seymour
How to Select Furnace Tubing — Part I C-54
Thomas M. Krebs
The Refining Engineer's Process Notebook C-61

OIL AND GAS PIPELINING

University of the Andes Correlates Studies with U.S. Institutions D-17
Colombia's Pipeline Network Expanding D-20
Waldemar Bellon
Laying Pipelines in Colombia Is a Rugged Business D-24
Wilson N. Gilliat
One Station Controls Entire System's Operation D-27
M. U. Bagwell
A Compressor Station is Overhauled D-30
IDEAS AT WORK: Tools Do the Job Better D-32
Gas Treating by New Method D-34
Westcoast Stations Designed for Cold Weather Operation D-36
Leslie Orr Rowland
First Ethylene Pipeline Built for Interstate Shipments D-42
Canadian News Notes D-51

FEATURES

Course of Oil A-4
Advertisers' Index A-6
Petroleum Profile A-8
J. C. Donnell, II
Highlights A-12
Meetings A-18
Management Personals E-9
Laugh with Barney E-10
The Trade Parade E-11
Of Things to Come in Oil B-3
Exploration Activities B-112
What's Doing in Drilling B-124
Running Tour with Men in the Industry B-128
New Equipment B-146
New Literature B-150
New Refining Projects C-3
Refining Books to Read C-60
New Equipment C-69
New Literature C-70
Pipeline Developments D-3
Pipeline Personals D-46
Pipeline Projects D-49
With the Pipeline Contractors D-53
New Equipment D-56
New Literature D-58

Four Editions
Published Monthly by
The Petroleum Engineer
Publishing Company
800 Davis Building
Dallas 2, Texas

the Petroleum Engineer
FOR MANAGEMENT
INTEGRATED EDITION OF THE PETROLEUM ENGINEER

the Petroleum Engineer
DRILLING AND PRODUCING
SPECIALIZED EDITION OF THE PETROLEUM ENGINEER

the Refining Engineer
SPECIALIZED EDITION OF THE PETROLEUM ENGINEER

the Pipeline Engineer
SPECIALIZED EDITION OF THE PETROLEUM ENGINEER

The Gilded Man

When the conquistadores pressed into South America they sought gold and precious gems. They marched on starvation rations, fought Indians, animals and insects, endured torrential rains, steaming heat and breathless altitudes. Always El Dorado was just beyond the horizon. There was no rest for the 16th century adventurer.

In her "Gateway to South America," Kathleen Romoli quotes authorities who name Guatavita, a deep round lake near the summit of a peak in Colombia, as El Dorado — "The Gilded Man."

There an ancient chief covered himself with resin and powdered gold dust over it to make sacrifices to his god. There, north of Bogota, the offering of gold and emeralds brought by nobles and common people, were thrown into the little sacred lake.

Estimates of the wealth under the water and mud run into astronomical figures. Costly expeditions have found the lake well guarded by nature. The gold and gems have sunk in deep mud that, exposed to air, hardens like cement. Little has been recovered — an emerald the size of an egg, a priest's mitre and staff in wrought gold.

The story of the Gilded Man — El Dorado — is also the story of the petroleum industry in Colombia. Expeditions to find buried oil and gas are costly and uncertain.

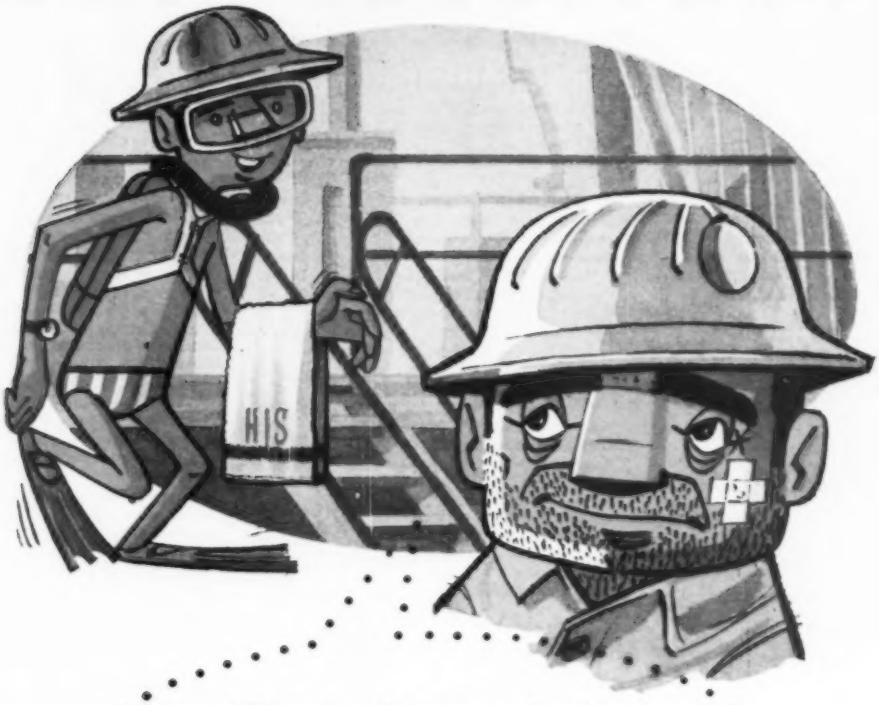
Determined men have followed forbidden trails into jungle-covered mountains and malaria-infested marshlands; they have plied unpredictable waterways, and hovered in helicopters over isolated camps.

They have found a billion and a half barrels of oil and have produced a little more than half. You can calculate the potential of El Dorado as easily as you can the potential of petroleum under the Andes and the Llanos. The discovery of oil in the future, however, will be vastly more important to Colombia than all the riches in the Lake of Guatavita.

We still seek the wealth of the earth, but the dream has changed. The hard shining gold of old gives way to dark and flowing oil (preferably beside the sea or a pipeline). But the vision is still El Dorado — the Gilded Man . . . the always expanding goal . . . the legend Colombia gave us.

Ernestine Adams.

Congrats and $25 to Jim Howard, Gardner-Denver Co., P. O. Box 35106, Dallas 19, Texas, for this quip.

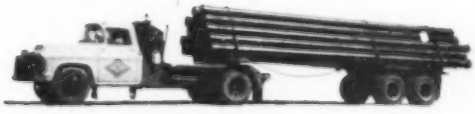


"Sez he's ready to check the water table."

Completely integrated facilities, from ore mines to finished product, plus quality control by accurate tests and inspections through each successive step of manufacture . . . guarantee the fine API quality of Lone Star pipe.

Construction of our new open hearth furnace and stretch-reducing mill is proceeding on schedule . . . which will mean Lone Star fully normalized casing, tubing and line pipe in greater quantity. Joe Roughneck can depend upon Lone Star . . . because Lone Star is specifically dedicated to supplying Joe's casing, tubing and line pipe needs.

Neighbor, wherever you are, specify Lone Star and we both get a good deal.



Lone Star STEEL COMPANY

EXECUTIVE SALES OFFICES
W. Mockingbird Lane at Roper • P. O. Box 12226 • Dallas, Texas

DISTRICT SALES OFFICES

Houston, Texas
Tulsa, Oklahoma

Midland, Texas
Wichita Falls, Texas

Dallas, Texas
Shreveport, La.

ADVERTISERS' INDEX

A

Ajax Iron Works B-56
Aldrich Pump Company B-142
Allis-Chalmers D-9, D-10
Alten Foundry & Machine Works, Inc. B-123
American Iron & Machine Works Company, Inc. B-2
American Meter Company E-28
American Recording Chart Company E-17
American Steel & Wire Division, United States Steel Company E-30, E-31
Armco Steel Corporation, Welded Pipe Sales Division D-1
Armour Chemical Division, Armour and Company B-16
Atlantic Refining Company, The C-6
Axelson Manufacturing Company B-86, B-87

B

B and W, Inc. B-130
Babcock & Wilcox Company, The Tubular Products Division C-34
Baker Oil Tools, Inc. B-54, B-55
Baroid Division, National Lead Co. B-69a, B-69b
Bethlehem Supply Company E-10
Betz Laboratories, Inc. E-27
Black, Sivalls & Bryson, Inc., Oilfield Equipment Division A-16
Blaw-Knox Company, Chemical Plants Division E-1a
Brake-Sol, Inc. E-28
Bucyrus-Erie Company B-10, D-18

C

Cable Engineering B-130
Cabot Shops, Inc., Franks Division B-94
J. I. Case Co. B-67, B-13
Catawissa Valve and Fittings Company E-24
Caterpillar Tractor Company A-9, A-22
Caterpillar Tractor Company, Engine Division E-40, E-41
Christensen Diamond Products B-11
Colorado Fuel and Iron Corporation ... B-4
Colorado Fuel and Iron Corporation, Wickwire Spencer Steel Division ... B-131
Climax Engine Manufacturing Company B-101
Consolidated Electrodynamics Analytical & Control Instruments Division C-51
Chicago Bridge & Iron Company E-1g
Continental Emsco Company B-76, B-77, B-78, B-79, B-80, B-81
Crane Company D-41
Crose, M. J., Manufacturing Company, Inc. D-52
Crutcher-Rolfs-Cummings, Inc. D-47
Curtiss-Wright Corporation, Utica Division E-26

D

Darling Valve & Manufacturing Co. D-14
Davison Chemical Company C-47
Dearborn Chemical Company D-15
De Laval Steam Turbine Company D-12, D-13
Diamond Chain Company, Inc. B-136
Dodge Manufacturing Corporation B-65
Dorr-Oliver, Incorporated B-69
Dowell, Incorporated A-15, Inside Front Cover
Dresser Industries, Inc. A-22, A-23
Drilling & Service, Inc. B-14
DuPont, E. I., de Nemours & Co., Inc. C-35 C-36, C-59, C-68

E

Electric Auto-Lite Company, The, Industrial Thermometer Division A-18
Elgen Corporation, The B-72
Engelhard Industries, Inc., Chemical Division C-43
Equipment Engineers, Inc. B-118
Ethyl Corporation C-4, C-5

F

First National Bank in Dallas E-38
Fisher Governor Company E-32, E-33
Fluor Products Company Division of The Fluor Corporation E-1d
Fluid Packed Pump Company B-114, B-115
L. B. Foster Co. E-10
Foxboro Company, The ... C-64, C-65, D-8

G

Gardner-Denver Company B-119-B-122
Gaso Pump & Burner Mfg. Co. D-7
Gates Rubber Co., The B-139
General American Transportation Corporation Plate and Welding Division E-42
General Electric Company ... D-4, D-5, E-1
General Precision Laboratory, Inc. E-24
Guiberson Corporation, The B-18

H

D. W. Haering & Co., Inc. E-20
Halliburton Oil Well Cementing Company B-52, B-148, B-149, E-1c
Harbison-Fischer Manufacturing Company B-93
Harshaw Chemical Co., The C-1
Hercules Tool Company B-111
Hill-Hubbell & Company Division of General Paint Corp. D-19
Houston Oil Field Material Co., Inc. B-133
Hughes Tool Company ..... Back Cover
Humble Oil & Refining Company C-53
Hycalog, Inc. B-127
Hydril Company B-41

I

Ingersoll-Rand C-52a, E-13
International Harvester Company E-29

J

Jensen Bros. Mfg., Inc. B-126
Jones & Laughlin Supply Division B-5

K

Kane Boiler Works, Inc. D-50
M. W. Kellogg Company, Refinery Process Division C-66
Koehring Division of Koehring Company E-2
Koppers Company, Inc. A-18, D-48

L

Lane-Wells Company ..... Inside Back Cover
Layne & Bowler, Inc. E-39
LeBus International Engineers, Inc. B-49
Line Scale Company, Inc. E-21
Lone Star Steel Company A-5
Lufkin Foundry & Machine Company B-83

Mc

McCullough Tool Company B-60
McEvoy Company B-138

M

M & V Tank Company B-126
Mack Trucks B-6
Magnet Cove Barium Corp. B-97
Magnetrol, Inc C-70
F. H. Maloney Company D-44
John N. Martin, Manufacturer B-7
Manx Hotel E-43
Martin-Decker Corporation B-106
Mavor-Kelly Company D-47
Metallizing Engineering Co., Inc. E-21
Minneapolis-Honeywell Regulator Co., Industrial Division D-16
Lee C. Moore Corporation B-89
Mueller Co. A-16a, A-16b

N

National Supply Company, The B-107-B-110
National Tank Company E-44
National Tube Division, United States Steel Corporation C-39
Nibco, Inc. D-50
Norberg Manufacturing Co. A-10
Nordstrom Valve Division, Rockwell Mfg. Co. E-18, E-19

O

Oil Center Tool Co. B-1
Oil States Rubber Co. B-102
Oilwell Supply Division United States Steel Corporation A-7
Orbit Valve Company B-137
Otis Engineering Corporation B-100

P

Pacific Coast Borax Division, United States Borax & Chemical Corporation E-15
Parsons Company D-37
Pelican Supply Co., Inc. D-51
Perforating Guns Atlas Corporation ... B-144
Petroleum Electric Power Association A-20
Petroleum Equipment Suppliers Association B-103
Petreco Division, Petrolite Corporation .. E-1e
Pipeline Cleaners Co. D-51
Pipelinings Division, American Pipe and Construction Company E-43
Pittsburgh Coke & Chemical Co. D-2
Polyken Sales Division, Kendall Company, The A-19
William Powell Company, The C-67
Procon International, S. A. C-48, C-49
Proportioneers Division of B-I-F Industries C-27

R

Radiator Specialties Co. C-69
Rector Well Equipment Co., Inc. B-8
Rectorseal E-43
Reed Roller Bit Company B-140, B-141
Reda Pump Co. B-92
Republic National Bank of Dallas A-1
Ridge Tool Company, The E-13
Rockford Clutch Division, Borg-Warner .. B-96
Rust-Oleum Corporation A-17

S

Salt Water Control, Inc. B-12
Schlumberger Well Surveying Corp. B-90, B-91
Security Engineering Division B-145
Shaffer Tool Works B-116, B-117
Sikorsky Aircraft B-63
Solvay Process Division, Allied Chemical & Dye Corporation C-69
Somerville Construction Co. D-51
Southwest Industries, Inc. B-9
Spang & Company B-113
Standard Oil Company of California A-13
Standard Oil Company (New Jersey) .. E-34
Steel Forgings, Inc. D-57
Stewart & Stevenson Distributing Co. B-134, B-135
Stitt Ignition Company E-24

T

Texas Company, The E-37
Texas Metal Fabricating Co. C-63
Thompson Tool Co. E-12
Thornhill Craver Co. B-15
Transcontinental Gas Pipe Line Corporation E-16
Tretolite Company B-104, B-105
Twin Disc Clutch Co. B-19

U

Union Switch Signal Division, Westinghouse Air Brake Company B-45
Universal Oil Products Co. C-32, C-33

V

Henry Vogt Machine Co. C-2

W

W-K-M Division, ACF Industries .. B-73, E-1h
W. L. Walker Co. D-57
Walworth Company E-1f
Waukesha Motor Company B-45
Welex, Inc. B-71
Well Equipment Manufacturing Co. B-132
Western Company, The B-143
Western Gear Company D-35
Western Supply Co. C-56
Wheland Company, The B-98
T. D. Williamson, Inc. D-54
Wilson Manufacturing Co., Inc. B-125
Wilson Supply Co. B-99

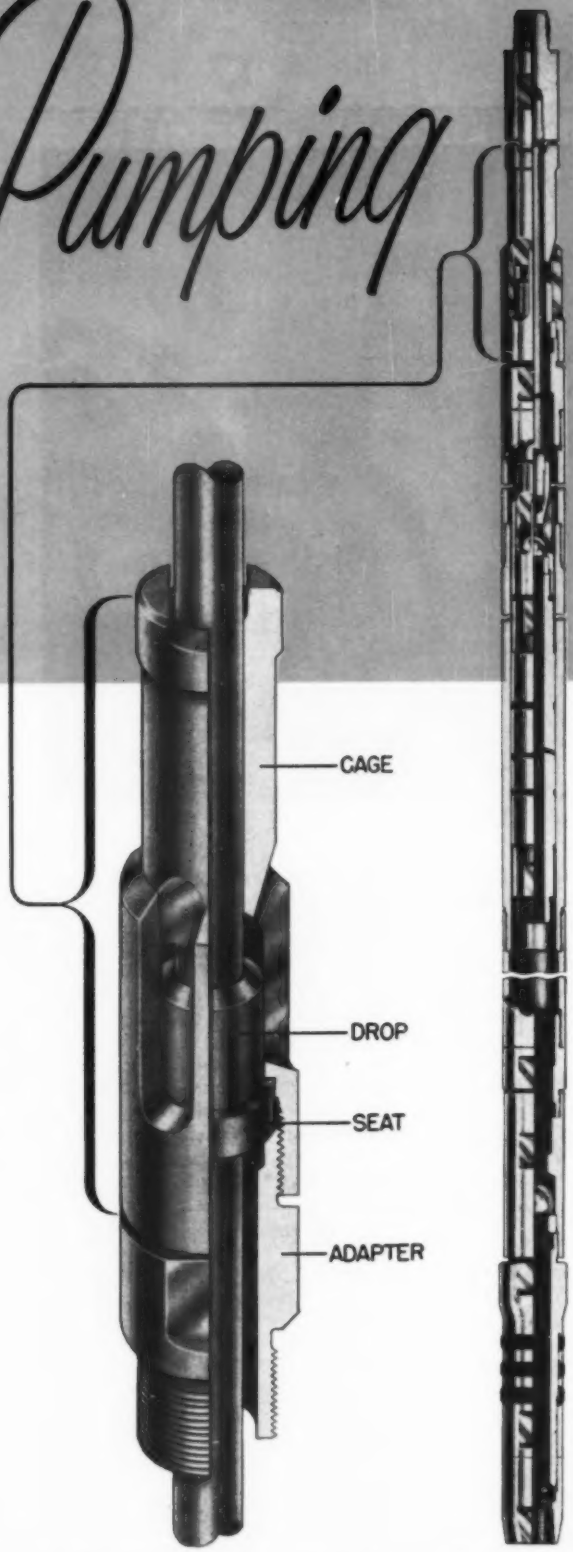
Y

Youngstown Sheet and Tube Company E-7

THIS INDEX IS PROVIDED AS AN ADDITIONAL SERVICE FOR OUR READERS—THE PUBLISHER ASSUMES NO RESPONSIBILITY FOR ERRORS OR OMISSIONS

Pumping in Sand?

Protect your subsurface pump with the "Oilwell" Sand Check Cage!



The Sand Check Cage is typical of the many quality features which make "Oilwell" subsurface pumps so outstanding. This cage is equipped with a drop valve which fits loosely around the valve rod. It rises on the upstroke of the plunger to permit the discharge fluid to wash away sand. It closes on each downstroke to prevent sand from settling in the pump barrel.

When the pump is shut down, no sand can enter the barrel. When pumping is resumed, sand above the pump is quickly washed away. But if that sand were in the barrel, it would have to be washed away on the very first stroke, or the pump would score and eventually jam. Then you would have a costly pulling job and replacements.

The Pump Specialist at your nearest "Oilwell" store will demonstrate this device, and can include a Sand Check Cage assembly in your next pump if conditions warrant. The Sand Check Cage with its replaceable seat is an *exclusive* on "Oilwell" Subsurface Pumps . . . and can save you many times its cost in floating-sand wells.

OIL WELL SUPPLY
DIVISION
UNITED STATES STEEL CORPORATION

Executive Offices—DALLAS, TEXAS
Export Office—
30 ROCKEFELLER PLAZA
NEW YORK 20, N. Y.

Area Offices—
CASPER, WYOMING.....COLUMBUS, O.
DALLAS, TEXAS.....HOUSTON, TEXAS
TULSA, OKLA.....LOS ANGELES, CALIF.
CALGARY, ALBERTA

Branches Serving All Oil Fields

USS TRADE MARK

"OILWELL"

TRADE MARK

UNITED STATES STEEL

Petroleum Profile

J. C. DONNELL II
President
The Ohio Oil Company

YOU can set up a list of qualifications for an oil company president and check them off one by one for J. C. Donnell II. He has them.

He has the education and the experience, the quick incisive mind, the ability to lead his management team; he has apparently an inexhaustible energy and a calm, deliberate manner. All the essentials to head a large company.

But the quality that levens these enviable traits is the illusive yet strong impression that Mr. Donnell is struggling along with his fellow workers to reach a new goal.

In other words, the president of The Ohio Oil Company doesn't give off an aura of static success. He's in there working for it.

Since Ohio Oil, once part of Standard Oil Company, became an independent company in 1911, a Donnell has been head of the firm. First J. C. Donnell I, who began as an oil field worker; then Otto D. Donnell, his son, who served from 1927 to 1948.

Young Jim, silver spoon child or no, went to work at the age of 10 as a messenger boy during summer vacations at Findlay, Ohio, the general office. When he was 14 he worked in the traffic department. His grandfather took him on many field trips during his teen years and young Donnell sat in on many important oil deals. Characteristic of such meetings, his grandfather would often turn to him and say, "What's your opinion on this, Jim?"

At the ripe age of 16 his summer was spent working at the Robinson, Illinois, refinery when it was being rebuilt. The 1928 and 1929 summers were spent in Salt Lake City on gas operations. His wise father, who served as president during the strenuous years of the depression, through World War II and the early post war years, prepared Jim with knowledge and appreciation of the petroleum industry.

You might say that in the meantime he went to school. The fact that he was awarded Phi Beta Kappa and Sigma Xi memberships indicate he studied wholeheartedly. As soon as he was graduated from Princeton University in 1932 he went to work full time for Ohio Oil.

Another important event in his life came that year; he and Miss Dolly DeVine of Ogden, Utah, were married July 2. They have one child, Susan.

Although Donnell's major at Princeton was geology, his first full time job was crude oil sales. He'd had at least a taste of nearly every operational department before he was taken into management, which is one good reason why those who work with him find him an understanding president.

The top post came on May 27, 1948, when J. C. Donnell II was elected president of the company to succeed his father. He was only 38 years old, but remember, he'd started his first job 28 years before.

And how has he done — this man so carefully trained?

The best place to look for the economic answer is in the annual report. In the years since the third Donnell has been president, business has continued to move ahead. Book value of the company was $174 million when J. C. Donnell II stepped up to the head; today it is $336 million. The company is expanding into foreign oil operations in both hemispheres.

The Research Center, Denver, Colorado, is a project unique in petroleum industry history. It was organized from scratch with a highly competent staff and a modern, efficient plant ready for new ventures, all within a year's time.

The company report reflects one basic precept that Ohio Oil's president weaves into all his actions: That people are the important part of all operations.

"A company of people . . ." the 69th annual report begins.

Not only in the company does Mr. Donnell concern himself with others. He is intensely interested in training and education for youth.

He is a past president of the National Council of the YMCA, a member of the Executive and President's Committees of the World Council.

To further education he serves actively as trustee of Bowling Green State University and as a member of the Advisory Council of the Geologic Department of Princeton. George Williams College recognized his significant contributions to youth training and education by conferring upon him in June 1956 the honorary degree of Doctor of Laws.

Donnell holds many business and industry memberships. He is on the API Board and Executive Committee; served two years as vice president for production. He is a member of the National Petroleum Council and a director of National Industrial Conference Board.

The extraordinary part of this picture of crowded activity is that Mr. Donnell not only belongs; in each case he contributes his growing experience and knowledge.

On the recreation side he plays better than average golf or bowls when he can, but he operates on a tight schedule, to get in as much effort as he can for the things he believes in.

EXCLUSIVE CATERPILLAR "HI-ELECTRO" HARDENING MAKES STEEL TOUGH TO BREAK, HARD TO BEND

Result: New CAT Scraper and 'Dozer cutting edges, built to withstand increased demands of today's machines, are top buy.

The cutting edge of a bulldozer or scraper takes more punishment than any other part of the machine. And more punishment today than ever before. New, larger, more powerful machines make greater demands on cutting edges.

New Caterpillar cutting edges match the superb quality and performance of Caterpillar earthmoving equipment. They are built to stay on the most grueling jobs, day after day, without breaking or bending. There is no better buy at any price.

Field tests prove that the new Cat cutting edges not only outwear other make edges of the same thickness; they even outlast the thicker edges of other manufacturers.

To manufacture such tough edges, Caterpillar engineers perfected a hardening process to give steel the right blend of toughness and hardness—toughness to prevent breaking, hardness to prevent bending and rapid wear.

ROUGH JOBS like this put cutting edges to severe test. And here is where tough Caterpillar edges prove their superiority.

A quality edge starts with quality steel, tested in Caterpillar's laboratories for the right chemical composition and physical characteristics. Only steels meeting these exact specifications are accepted, and further tests are made at every stage of production.

Edges are heat treated by "Hi-Electro" hardening, a Caterpillar exclusive. This gives a deep, superhard wear case. The core is left tough. The finished edge has an armor-like case and a shock-absorbing core.

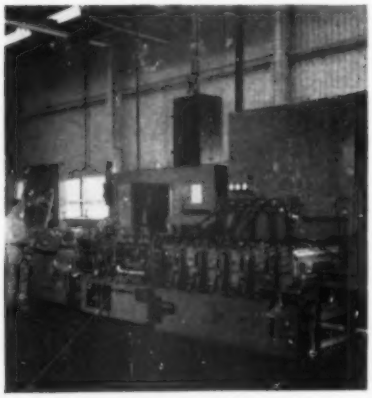
Your Caterpillar Dealer has full information about the new Cat Scraper and 'Dozer cutting edges. See him today.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

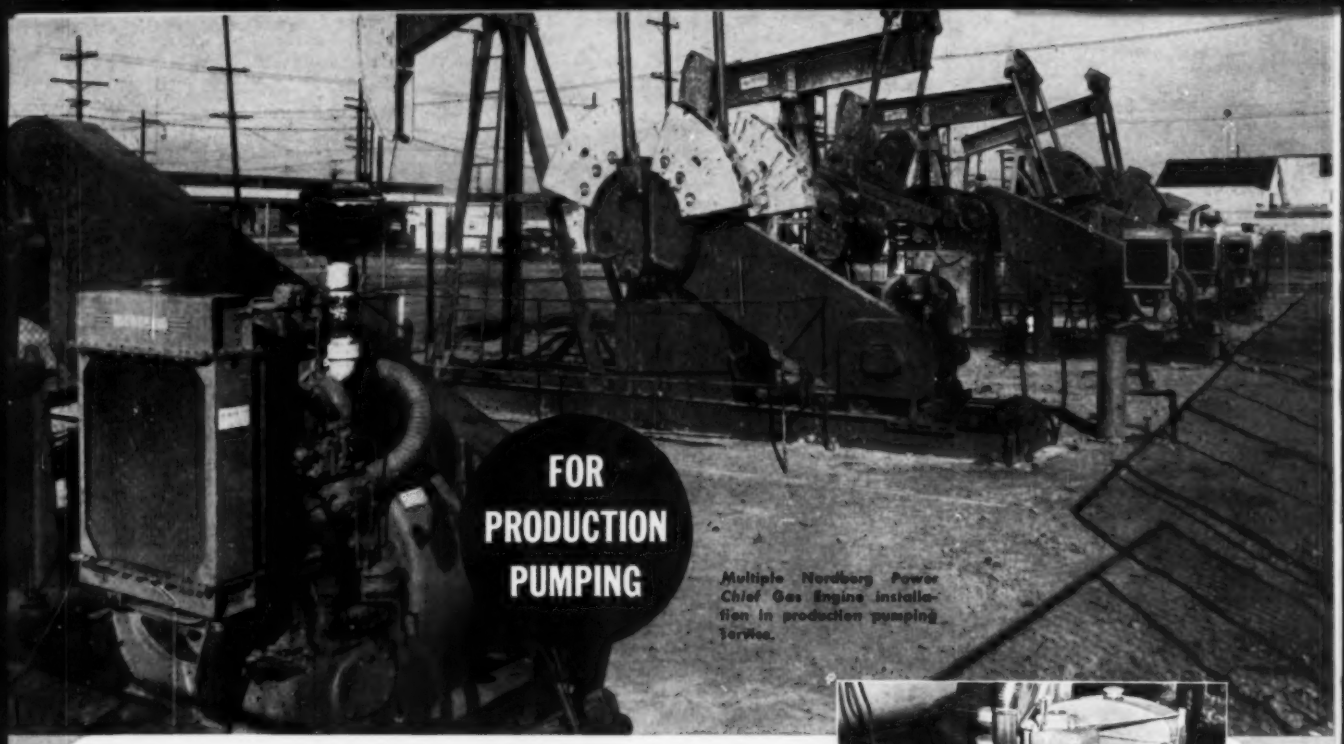
CROSS SECTION of edge showing armor-like case and its shock-absorbing core.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.



"HI-ELECTRO" hardening machines at the Caterpillar factory give cutting edges the strength to resist breaking and bending.



Multiple Nordberg Power Chief Gas Engine installation in production pumping service.

NORDBERG POWER CHIEF® ENGINES

are your BEST BUY!

In the low cost medium speed field, *Power Chief* engines give you all the design, construction and fine quality that has made Nordberg engines famous throughout the world for over 50 years. *Power Chief* engines are so simple in design that they can be maintained, in the field, with only a few ordinary hand tools.

Here are some of the features that make *Power Chief* engines your *Best Buy:*

Removable wet cylinder liners • Valves in head • Replaceable valve guides • Special alloy inserted exhaust seats • Positive full pressure lubrication • Internal ventilation bars entry of dirt • Crankcase and all other vital parts fully sealed • Oil heat exchangers maintain proper internal temperatures at all loads • Safety approved, enclosed heavy flywheel smooths out fluctuating loads • Fram oil filters • Vortox oil bath air cleaners • Wico & Bosch magnetos • Twin Disc clutches • Murphy safety shut-down devices. (No extra added costs for these when you buy.)

Power Chief Gas Engines in 1 and 2-cylinder models deliver up to 36 hp maximum rating. *Power Chief* Diesel Generator Sets produce 6 to 30 kw for continuous service. All are available with special vibration-proof mounting. NORDBERG MFG. CO., Milwaukee, Wisconsin

Typical rig-mounted Power Chief Diesel Generator Set for lighting service.

SEND FOR BULLETIN

Write for Bulletin describing Nordberg Power Chief Oil Field Engines.

AVAILABLE AT YOUR LOCAL SUPPLY STORE — OR CONTACT THESE AUTHORIZED DISTRIBUTORS:

NORDBERG

DIESEL and GAS ENGINES

4-657-O

© 1957, Nordberg Mfg. Co.

FRED E. COOPER, INC., Tulsa, Oklahoma
BRANCHES: Houston, Odessa, Olney
SALES & SERVICE: Casper, Wyo.; Corpus Christi, Longview; Lafayette, La.; Wichita, Kansas.

IN-MAR CO., Wilmington, California

STEPHENS OIL FIELD REPAIR, Fairfield, Illinois

MEAD ENGINE & WELDING WORKS, Sterling, Kansas

CORNELISON ENGINE MAINTENANCE CO., INC., Seminole, Oklahoma

ROGERS DIESEL ENGINEERING CO., New Orleans, La.

THE CONFERENCE TABLE

It looks like war — not of bloodshed — but of accomplishment . . . DR. J. ALLEN HYNEK

Capital Spending

U. S. business spending for plant and equipment in 1957 will top $37 billion, 6 percent more than the previous high of 1956. This is a government estimate.

The same source puts the first quarter of 1958 at 5 percent below, or at the rate of $35.5 billion for the year.

In the petroleum industry we see no downturn in 1958. Individual programs are mixed but totals look about like 1957. Gulf's outlay for exploration and investment is $692 million for 1958, highest expenditure in its history.

British American has scheduled $147 million for 1958, about 30 percent higher than 1957 investments.

Jersey Standard has dropped its total capital and exploration outlays to $1.25 billion, off about 11 percent from the 1957 program of $1.4 billion.

The Royal Dutch/Shell group spent $1.12 billion in 1957 and expect to spend the same in 1958.

Senor Edwardo Ospina-Racines

People in the oil industry think of E. Ospina-Racines when they think of Colombia. He has for many years lived at Bogota and from his office there keeps up with late information on petroleum operations all through South America. He has given us a large amount of information very briefly in his article on page E-3.

Seminar on Space

University of California threw out a Space Technology Extension Course almost as fast as the Sputniks were launched. Once a week, from January to May, in Los Angeles, San Diego, and San Francisco, lectures will be given by distinguished scientists on such subjects as "The Unknown Cosmos, Earth Satellites, Interplanetary Operations, Lunar Flight, Recovery Dynamics, Space Communications, Space Medicine, Exploration of Mars. Here is a course that is out of this world.

A Market Plug

Last year Value Line Investment Survey said petroleum stocks had risen too fast — had outstripped their earnings growth. Now the same specialists pat petroleum stocks on the head.

"The petroleum industry is one of the few that can look forward to rising revenues and profits scattered and dividend increases next year," says the survey, published by Arnold Bernhard and Company.

Two reasons are given for the brightening outlook: First, current weakness in products prices is likely to end due to the industry's determined efforts to work off excess inventories; second, a small increase in demand is expected.

Imbalance of supply and demand has plagued the petroleum industry this year. Rate of profit growth has faltered. In 1958, however, Value Line sees a stable demand for petroleum products. Reason: As a consumer goods industry, petroleum is relatively insensible to fluctuations in general business activity. Also, two factors are laying the groundwork for a recovery from 1957's dilemma:

1. *Reduction of Texas crude producing allowables, a major step toward working off inventories.*
2. *President Eisenhower's program for voluntary reduction of crude oil imports.*

Financial Notes

Ashland Oil and Refining has earnings of $16,219,277 for the year ending September 30, 1957. This is 20 percent higher than the previous year.

Net income of Murphy Corporation for 6 months ending November 30, 1957, was $1,341,000 or 74 percent above the same period the year before.

Royal Dutch/Shell group of companies (60 percent plus 40 percent interests, respectively) had a striking increase for nine months of 1957 compared to 1956. A whopping 27 percent rise might be laid to the Suez conditions early in 1957 but certainly not all of it. The third quarter showed a substantial 18 percent gain over the same period in 1956.

Both Royal Dutch and Shell are making new offerings of stock. Royal Dutch issue totals $228 million and Shell Transport and Trading amounts to $126 million.

Employees Own Million Shares

Employee ownership of Socony Mobil Oil Company, Inc. has crossed the million-share mark. Total includes only those shares purchased through company's employee savings plan. Many employees own shares acquired outside the plan. Some 38,000 of 44,000 employed in the United States participate in the plan.

Transportation is a headache in most of Colombia. Mules and horses carry men into the jungles and swamplands. Or they did until International Petroleum Company ordered some snow bombardiers from Canada. Now drilling and producing staffs take off across shallow waters and marshlands loaded with gear in their sturdy bombardiers. If this gets stuck we don't know what'll pull it out.

HIGHLIGHTS ★ ★ ★

Digest of News and Comment

West Coast Importers Comply

Voluntary restrictions on imported oil to the West Coast are meeting with early approval of the 18 companies involved, cites Oil Import Administrator Capt. M. V. Carson. A telegram dispatched to the importers on December 24 brought 11 replies — all favorable — in the one holiday week ending December 31.

Domestic Crude Drop Due

Bureau of Mines estimates that the U. S. oil industry will see its first reduction in annual output since 1954. It predicts that domestic crude production in 1958 will average 7,037,000 bbl daily, about 1.8 percent less than the estimated daily output in 1957. Total demand for all oils, including exports, for the new year is predicted to be only 2000 bbl more per day than the estimated 1957 total demand of 9,367,000 bbl.

No Gloom in Steel Industry

The steel industry's 1958 gross sales will equal or exceed last year's high mark, predicts *Steel* magazine. The magazine's report was based on favorable outlook comments by 70 percent of the nation's 7500 steel plant general managers. "As the steel industry goes, so goes oil," one industry spokesman of a few years ago reminds us.

Muttnik Not Affecting Gulf

"Exile of one Russian dog into outer space . . . is not the beginning of the world's end," proclaims the management of Gulf Oil Corporation in its decision to budget $564,000,000 for expansion and improvement of facilities this year. The capital outlay is the biggest in the company's 56-year history. An additional $128,000,000 will be spent by Gulf for geophysical exploration and wildcat drilling — three-fourths of it to be spent in the U. S.

Gulf Takes All

Gulf Oil Corporation began taking 100 percent of allowables in New Mexico and Louisiana in the month of January, areas where it had been prorating its purchases for several months. The company also nominated and is taking crude oil in Texas at the full allowable rate. This was on a 12-day basis, as set by the Railroad Commission, in January. Gulf bowed out of the Oklahoma crude buying picture late in 1957 by selling its lines to Kerr-McGee Oil Industries.

Miles of Smiles

A stepped-up program of highway construction is being scheduled by the federal government, says Commerce Secretary Weeks, in an attempt to "strengthen public confidence" and to provide "new push to production and employment." Increased expenditures in this and other areas of government spending ($74 billions) will leave no room for tax reductions, the officials are quick to point out.

Gas Can Live With FPC?

Natural gas rates can be regulated on a public utility-type basis without hurting future supplies, the American Economic Association was told. Dr. Joel B. Dirlam, a consultant with Boni, Watkins, Jason & Company, stated that despite controls, exploration activity has been sufficient to satisfy the gas supply needs. He also indicated that he doubted price of gas had much effect on its supply, either in the short or long run.

Depletion Tax Faces Test

One of the first actions of the new Congress involved the oil industry and its right to the depletion provision in the income tax for oil and gas production. Secretary of Treasury R. B. Anderson, long associated with oil in Texas, testified in its behalf before the House Ways and Means Committee. Backing him up on the testimonial docket were 300 persons associated with oil companies and oil associations, to be called upon if needed.

IOCC Takes 28th Member

Governor Michael A. Stepovich, Territory of Alaska, has executed Alaska's compact to make it the 28th member of the Interstate Oil Compact Commission. The territory authorized the governor to sign the act in 1953, but needed actual discovery of oil there to confirm membership. This came with the recent oil find on the Kenai Peninsula by Richfield Oil Corporation.

Texas Producers vs Pipelines

Connection-of-oil-wells-in-Texas-by-pipelines controversy has entered its second year, with no end in sight. The State Railroad Commission ended its hearings on the subject in January, but may be tossed through the courts. The original protest was filed by producers who said pipeline connections were needed for 8400 Texas wells. Pipeliners say they have kept pace with lines where feasible. Texas producer groups are now looking to Oklahoma's new requirement forcing pipelines to take full allowables or "show cause" as an alternate means of getting crude to market.

One Reason It Costs More To Find Oil:

MORE WILDCAT WELLS ARE DRY

1947	1956
79.7%	84%
WERE DRY	WERE DRY

American Association of Petroleum Landmen

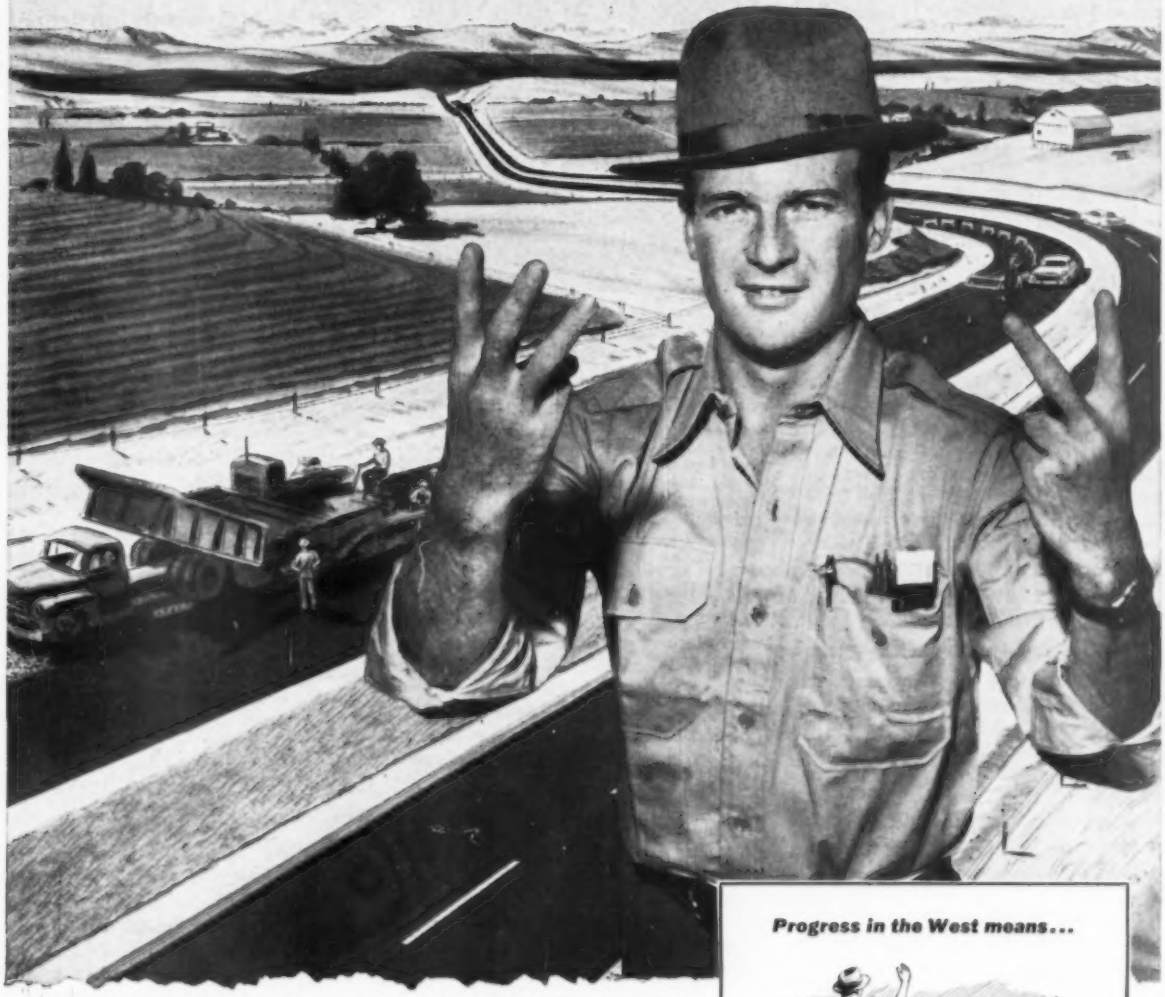
Colombian Schedule of Religious and Civic Holidays

Holidays vary in different countries. It may be useful to you to know those in Colombia, which are:

January 1	New Year's Day
January 6	Epiphany
March 19	St. Joseph's
May 1	Labor Day
May 15	Ascension Day
June 5	Corpus Christi
June 13	Sacred Heart
July 20	National Independence Day
August 7	Battle of Boyaca
August 15	Assumption Day
October 12	Christopher Colombus
November 1	All Saints
November 11	Cartagena Independence Day
December 8	Immaculate Conception
December 25	Christmas Day

Provided by Shell Condor, S. A.

How Standard helps your tax dollars buy 3 miles of superhighway for the cost of 2



Asphalt can save billions of dollars on the 41,000 miles of superhighways the U.S. will build in the next 15 years

Heavy Duty Asphalt Costs 20% to 50% Less Than Other Pavements. This means extra miles of superhighways for your tax dollars . . . smoother, more enjoyable miles, too. Safe, skid-resistant asphalt cuts down headlight and sunlight glare, makes lane markers easy to see.

To help bring you more miles of superroads faster and at lowest cost, Standard* operates nine asphalt refineries across the nation. Our scientists work with highway engineers on improved construction methods and the kind of low-cost maintenance that can make asphalt highways even better and stronger after many years of service.

Progress in the West means...

over 50,000 miles of new and improved highways by 1970

**Through Standard's wholly owned subsidiary, American Bitumuls and Asphalt Company*

STANDARD OIL COMPANY OF CALIFORNIA

plans ahead to serve you better

Pemex Asks British Credit

President of the British Board of Trade told a round table conference of banking and business leaders at the National Bank of Foreign Commerce that discussions with Petroleos Mexicanos Manager Antonio J. Bermudez discussed purchase of oil equipment from British manufacturers valued at $60,000,000. Suggestions were made, says Sir David Eccles, that British suppliers might authorize credit and that LPG gas might be sold to Britain.

Shale Oil to Market

More than 12,000 bbl of fuel extracted from solid oil shales in western Colorado have now found industrial use "with no noticeable difference in quality from oil previously used," reports Union Oil of California. Sale of shale oil is secondary, say company officials, since present production has been for the purpose of research. Marketing, although welcomed, is not yet commercial and does provide fuel storage for additional research. Users of oil shale for the most part have been in nearby reduction mills for uranium ore and in molybdenum processing plants. The product goes directly from Union's plant to the user without further processing or refining.

Research Addition for Ohio

Construction of two new wings to the Ohio Oil Company research center in Littleton, Colorado, will begin in March. Additions to the present structure will increase the area 60 percent to some 70,000 sq ft. The new wings will contain an enlarged library, a computer room and various laboratories and professional offices. The center, which was first built in 1956, will be able to house 170 persons — 105 directly engaged in research work.

Annual Index for 1957
The Petroleum Engineer

The editorial index of articles published in all editions of *The Petroleum Engineer* during 1957 is now available.

Subscribers wishing to receive a free copy should write to this magazine, P. O. Box 1589, Dallas, Texas.

Please state company position and don't forget to include your address.

For the first time since 1953 the office of the International Petroleum Exposition in Tulsa has been opened in preparation for the May 14-23, 1959, exposition commemorating the 100th anniversary of the petroleum industry. J. L. Shakely, (second from left) treasurer and member of the executive committee holds some of the requests for space from firms which have never been in the show before. Mrs. Virginia Davis, assistant to the treasurer, John Bridenthal, assistant manager, and William B. Way, (right) general manager, look on.

Shell Reorganizes in Canada

A corporate reorganization of Shell Oil Company in Canada has resulted in establishing Shell Oil Company of Canada, Ltd. Under the same management, Shell of Canada will carry on business at the area and division offices formerly occupied by Shell Oil Company.

Mercury Thefts Rise

Agents of Texas Mid-Continent Oil & Gas Association note with bewilderment a fast-rising epidemic of mercury thefts at various gas-handling operations in the Gulf Coast area. Investigators report that experienced thieves are tapping meters containing an average of 11 lb of mercury— currently priced at $4 per lb. Enforcement agencies say they are "mystified as to what the thieves are doing with mercury in these amounts, for its normal market is limited mainly to highly technical uses." Possession of the metal without bill of sale is a felony.

No Red Tools for Argentina

Argentina's proposed trading missions with Russia to buy critically needed drilling rigs have brought strong protests in the capital city of Buenos Aires. Almost immediately after the government announced the mission, posters went up, reading, "We do not want our oil to feed the war machines of the Red army, executioner of peoples." There is a strong feeling in Argentina against allowing foreign oil companies to operate within its borders, in spite of definite needs for means to develop an adequate oil industry there.

Solid Fuels Research Intensified

Phillips Petroleum Company is making plans to expedite its research, development and manufacture of higher energy solid fuels, propellants and devices for use in rockets and missiles. Phillips, long active in this field, has announced that it is entering a joint venture with North American Aviation, Inc. to specialize in the missile-rocket power field. A new company, Astrodyne, Inc., is to be formed and will operate from headquarters at Air-force Plant 66, near McGregor, Texas, where Phillips has been conducting sold propellant research, development and manufacturing for the Air Force since 1952.

Saud for Oil Shakeup

As a result of the signing the Saudi-Japanese offshore oil agreement allowing Arabia to keep 75 percent of the profits, King Saud has ordered that agreements with Arabian-American Oil Company be studied. The Aramco deal with Saudi Arabia calls for a 50-50 split, but Premier Prince Feisal has indicated that if this agreement contains clauses which stipulate alteration, "we will demand a change." New companies interested in Arabia have already been told that the government will require more than 50 percent profit.

Gasoline Tax Cut!

Oklahoma's gasoline tax, previously the highest in the U. S., dropped back to 6½ cents a gallon in the closing days of 1957. A temporary tax of 7½ cents per gallon had been in effect since June 1957, the extra penny being spent for flood-damage relief.

Albania Now Oil Sufficient

Albania set new oil production records in 1957, according to a Russian dispatch from Tirana. Output during the first eight months of 1957 almost equaled production for all of 1956 — which was estimated at 280,000 metric tons. Goal for 1960 under Albania's second five-year plan is 900,000 metric tons. The new Cerrick refinery (activated in November 1956) and the recently-rebuilt Stalin City refinery have a combined annual output of 300.000 metric tons — make Albania self-sufficient. Additional refineries are scheduled for early construction.

Good Wells Make Good News

A Monthly Report Of Successful Well Treatments

February, 1958

Operators who want to reduce production costs and increase ultimate recovery and profits are using Dowell acidizing more and more. Here are some recent examples showing how Dowell "tailors" acid treatments to the requirements of the well.

- **Plaquemines Parish, South Louisiana.** Dowell acidizing increased gas production from 2 million to 4 million cfd at a cost of $1003. Treatment paid out in about 5 days, based on 10 cents per thousand for gas. This well, in the Main Pass area, was completed in the Miocene sand (7967 to 7978 feet). A three-stage treatment was used, beginning with 500 gallons of low surface tension acid. Next, 500 gallons of Mud Acid was injected, then another 500 gallons of low surface tension acid. *This treatment has worked well in many Miocene sands. Although these sands exhibit low solubility in regular acid, many show 35 to 45 per cent solubility in Mud Acid.*

- **Galveston Bay, Texas Gulf Coast.** Gas delivery from this well was nearly tripled and the operator received a six-day payout as a result of a Dowell acidizing treatment. This well had been completed in the Frio sand (10,369 to 10,375 feet). Gas deliverability to the pipe line had declined to 692 mcfd. Dowell acidized, using 1000 gallons of low surface tension acid. Treatment down tubing averaged 1¼ bpm at 2900 psi, breaking to 1500 psi. Cost of the treatment was $480. *After treatment, deliverability rose to 1900 mcfd. This represented a net gain of over 1200 mcfd.*

- **McKenzie County, North Dakota.** Potential of this new well was increased from 41 bopd to 440 bopd after a treatment by Dowell using 2500 gallons of Mud Acid. This well, completed in the Sanish sand (10,320 to 10,330 feet) of the Antelope field, had tested 41 bopd before being killed with mud to set up for a dual completion. Since the packer was set at 9296 feet, a large volume of mud had to be removed from the annulus as well as the formation face. *Dowell treated with 30 gallons Freflo® in 33 barrels lease crude followed by 2500 gallons Mud Acid down tubing. Breakdown pressure was 8900 psi and acid was displaced at 5700 psi.*

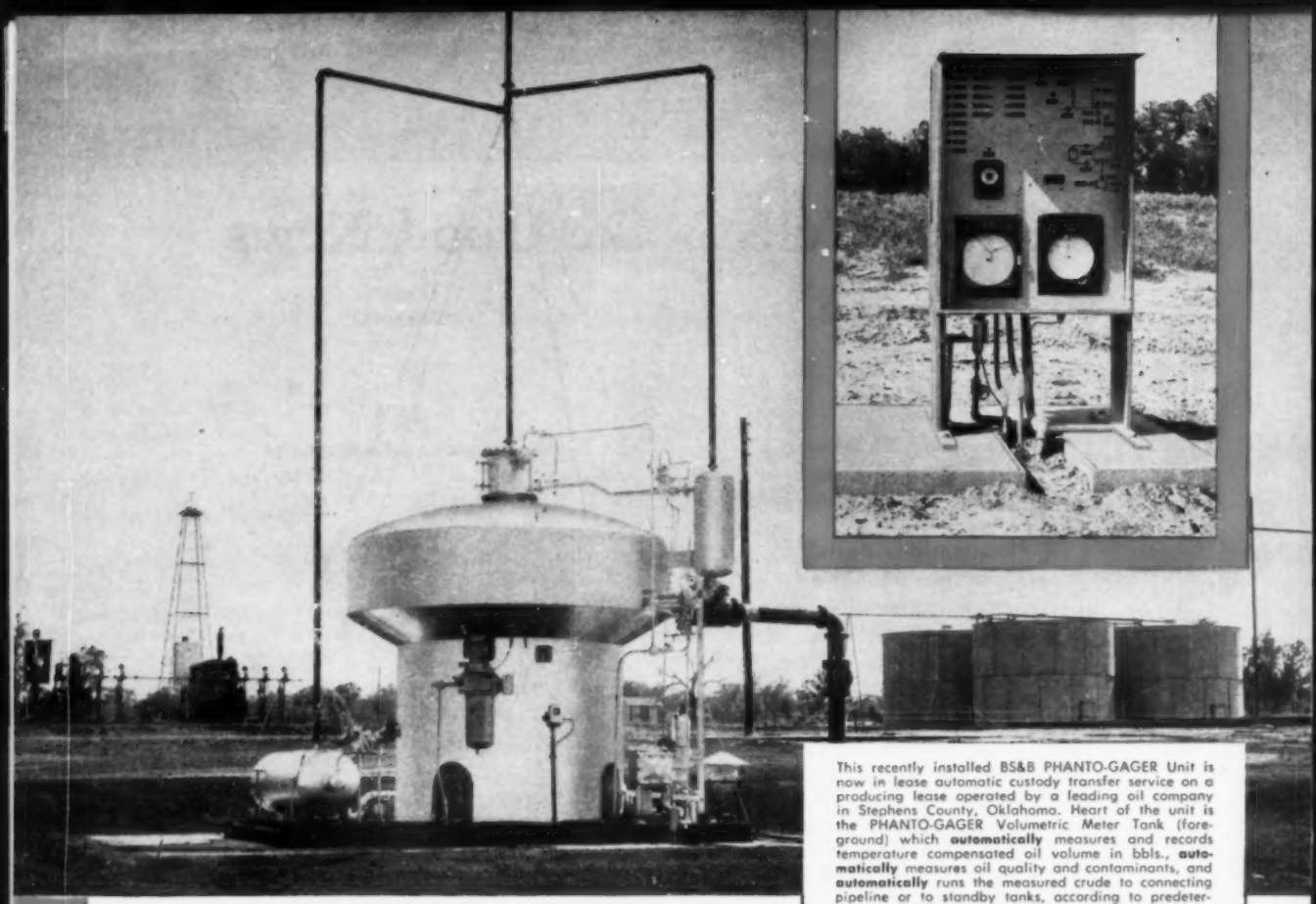
- **Beaver County, Oklahoma.** A new well potentialed 480 bopd through a ¼-inch choke after Dowell performed a two-stage acidizing treatment. The well, completed through perforations into the Chester lime (6542 to 6563 feet), died after 30 minutes flush production. Dowell acidized with 500 gallons Mud Acid, and the well was swabbed. Then 5000 gallons Retarded Acid was injected down tubing at 4 bpm and at pressures ranging up to 1000 psi. *After the well was swabbed clean, it made 292 barrels of oil in the first 8½ hours.*

Dowell now offers 41 addition agents to "tailor" acid to your requirements. Moreover, your Dowell engineer has an unparalleled fund of experience and laboratory facilities upon which to draw when he helps you plan a treatment. Each acidizing treatment he recommends is designed to give you the best results for your money. For more information or service, call any of the 165 Dowell offices in the United States and Canada; in Venezuela, contact United Oilwell Service. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

Services for the oil industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY



This recently installed BS&B PHANTO-GAGER Unit is now in lease automatic custody transfer service on a producing lease operated by a leading oil company in Stephens County, Oklahoma. Heart of the unit is the PHANTO-GAGER Volumetric Meter Tank (foreground) which **automatically** measures and records temperature compensated oil volume in bbls., **automatically** measures oil quality and contaminants, and **automatically** runs the measured crude to connecting pipeline or to standby tanks, according to predetermined schedules. The unit has been checked and fully approved by the pipeline company serving the area.

A Leading Oil Company Selects

BS&B *Phanto-Gager*

For Lease Automatic Custody Transfer

BS&B PHANTO-GAGER Units are offered for lease automatic custody transfer service in various sizes as skid-mounted assemblies, and with single or multiple metering and surge tanks. Fail-safe controls insure that no oil will be lost in case of power failure because:

1. The fill and empty valves on the meter tank are electrically interlocked.
2. Oil cannot be introduced into the meter tank after the measuring cycle has started, nor can oil be removed from the meter tank (other than to the pipeline) after the top gage has been made and before the run is completed.
3. All electrical controls, motors, instruments and wiring within 150 ft. of the meter and surge tanks are explosion proof.

The BS&B PHANTO-GAGER and the BS&B PHANTO-PUMPER, when used together, make up the complete BS&B PHANTO-MATIC Lease System which provides *full lease automation* from the wellhead to the pipeline. For full information, contact your nearby BS&B Man, or write to...

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Oilfield Equipment Division, Dept. 1-C 2

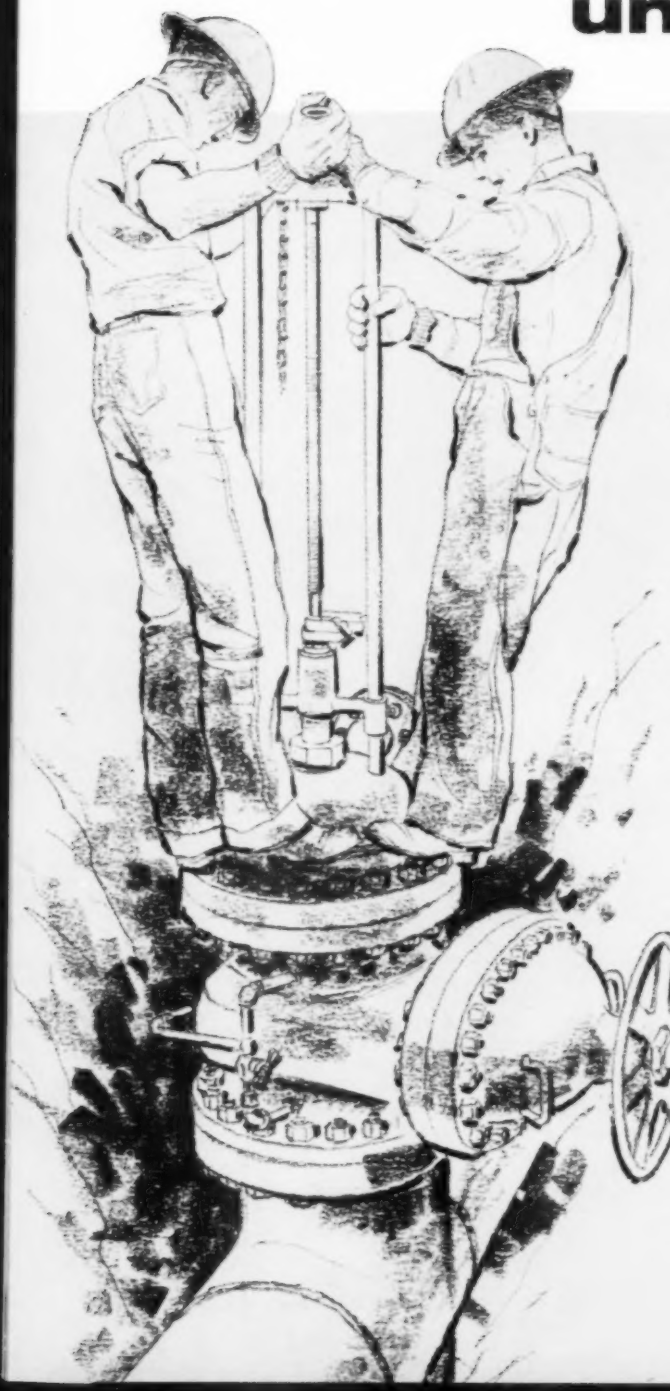
P. O. Box 1714

Oklahoma City, Oklahoma

MUELLER®

line stopper fittings and equipment

stop-off lines safely under pressure!



- *isolate sections of line*
- *tie-in lines and loops*
- *repair leaks and equipment*
- *replace and install equipment*

— without interrupting flow!

use this simple procedure:

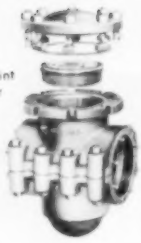
Weld or bolt stopper fittings to line.
Cut out section of pipe in fitting with drilling machine.
Mount stopping machines on fittings.
Install by-pass line.
Establish flow in by-pass line.
Lower stoppers and stop-off pipeline.
Blow-down isolated pipeline section.
Make repairs, tie-ins or installations.
Purge line and build up pressure in pipeline.
Relax and raise stoppers.
Remove by-pass line.
Plug and cap fittings.

Turn the page for full catalog information on Line Stopper Fittings and Equipment for 6", 8", 10" and 12" lines.

MUELLER NO-BLO PRODUCTS®

MUELLER CO.

H-17255
Welding
Line Stopper
Fitting



H-17265
Mechanical Joint
Line Stopper
Fitting

LINE STOPPER FITTINGS

Line stopper fittings are available in welding types in sizes 6", 8", 10" and 12" with 150 or 400 pound flanges or sizes 6" and 8" with 300 or 600 pound flanges. Mechanical joint fittings may be ordered for steel or cast iron pipe in sizes 6", 8", 10" or 12". The outside diameters, bolt circles and sizes of bolts of the flanges of these fittings comply with ASA Specification B 16.5-1953.

Sectional view of completion plug furnished with these fittings. Note straight threads, "O" ring seal and automatic equalizing valve which insure easy insertion and extraction under equal pressure plus pressure-tight seal.

Steel Wedge Stopper

Steel Protector Sleeve

STEEL WEDGE STOPPERS

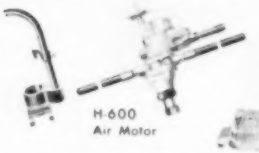
Mueller Steel Wedge Stoppers used with the 3SW and 4SW Line Stopper Units consist of an expanding mechanism inside a split steel cylinder. The cylinder is covered with a replaceable sheet of neoprene. A steel protector sleeve is furnished with each stopper to prevent damage to the cover when not in use. It also provides a means of applying bonding pressure when replacing the neoprene cover.

C1-36
Drilling Machine

MUELLER C1-36 DRILLING MACHINE

The C1-36 Drilling Machine is power-operated for making cuts from 2" through 12½" in any size of line. Maximum working pressure up to 500 p.s.i. at 100°F. or temperatures up to 500°F. at 250 p.s.i. are possible. Boring bar travel is 36". A built-in feed indicator is used to determine the distance traveled at any time. Feed may be automatic or manual and the crank handle provides rapid tool return.

POWER UNITS FOR THE C1-36



H-600
Air Motor

H-602
Gasoline Engine
Drive Unit

Either the H-600 Air Motor or the H-602 Gasoline Engine Drive Unit may be used to power the C1-36 Drilling Machine. The air motor holder and spindle attach directly to the C1-36 without adapters. For maximum performance, 90 cubic feet of free air per minute at 90 p.s.i. are required.

The portable gasoline engine drive unit utilizes a centrifugal clutch for easier starting and to prevent damage in the event of a stoppage. Cutting time with the gasoline engine drive unit is about equal to that of the air motor at recommended engine R.P.M.

H-17619
Inspection
Flange

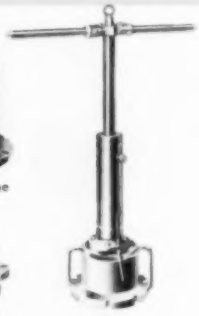
INSPECTION FLANGE

The H-17619 Inspection Flange is used with either the Unit 3SW or 4SW to visually inspect the results of the cutting operation. It is mounted on the drilling machine adapter and inspection is done under full line pressure. The retrieving rod may be used to raise any object which may interfere with the stopping operation such as chips, pipe scale or coupon, and to hold it above the gate valve until the valve may be closed and the object removed.

Shell Cutter
with Hub and
Pilot Drill

Drilling Machine
Adapter

Valve Adapter



H-17346
Completion
Machine

H-17340
Stopping
Machine

MUELLER LINE STOPPER UNIT No. 3SW

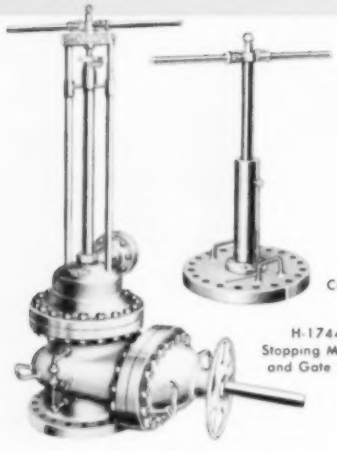
. . . for stop-offs on 6" and 8" lines

Mueller Line Stopper Unit No. 3SW is used to make stop-offs on 6" and 8" lines under pressures up to 230 p.s.i. at 100°F. or temperatures to 250°F. at 200 p.s.i.

The H-17340 Stopping Machine is used to insert, expand or extract 6" and 8" steel wedge stoppers. The steel body has a 2" by-pass connection. A special 9" gate valve and all needed tools are included.

The H-17346 Completion Machine has the balanced pressure design and is used to insert and extract 6" and 8" completion plugs. Tools are included.

Steel wedge stopper, valve adapter, shell cutter, hub and pilot drill are ordered according to the size of line to be stopped-off.



H-17440
Stopping Machine
and Gate Valve

H-17445
Completion Machine

Drilling Machine
Adapter

Shell Cutter
and Hub with
Pilot Drill

MUELLER LINE STOPPER UNIT No. 4SW

. . . for stop-offs on 10" and 12" lines.

Stop-offs may be made on 10" and 12" lines under pressures up to 500 p.s.i. at 100°F. or temperatures to 250°F. at 375 p.s.i. with Mueller Line Stopper Unit No. 4SW.

The H-17440 Stopping Machine is used to insert, expand and extract 10" and 12" steel wedge stoppers. It has a 4" flanged by-pass connection. A special 14" steel gate valve with 400# lower flange and all necessary tools, bolts and gaskets are included. (The H-17435 with a 150# flange on the gate valve is also available.)

The H-17445 Completion Machine is a balanced pressure machine used to insert and extract completion plugs. It includes all necessary tools and an inspection flange.

Necessary attachments include a steel wedge stopper, a drilling machine adapter and a shell cutter and hub with pilot drill.

Contact your Mueller Representative or write direct for full specifications on Mueller Line Stopper Units No. 3SW and 4SW. Other units available from ¾".

MUELLER
PRO-BLO
PRODUCTS

MUELLER CO.
DECATUR, ILL.

MUELLER CO. since 1857 SERVING the Water and Gas Industries QUALITY

Factories at Decatur, Chattanooga, Los Angeles.
In Canada: Mueller, Limited, Sarnia, Ontario

Form No. PL-8870

STOP RUST!

with

RUST-OLEUM®

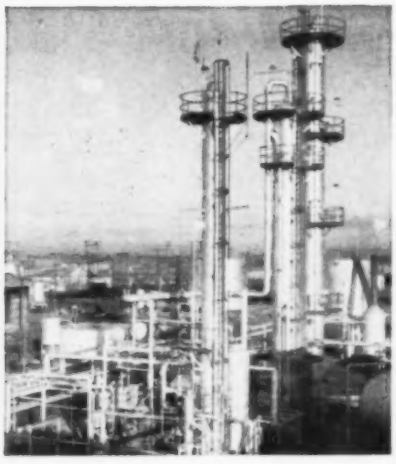
and match original equipment

COLORS

Resists Salt Air, Salt Water, Sun, Heat, Fumes, Blowing Dust and Sand—Yet Dries Quickly and Hard to a High Gloss Finish!

Do the job right in the field—right over the sound rusted surface! Just scrape and wirebrush to remove rust scale and loose rust — then brush or spray Rust-Oleum 769 Damp-Proof Red Primer (or H-50 Primer) over the remaining rust. Then—follow-up with the Rust-Oleum finish coat to match the original manufacturer's colors. That's all there is to it. Applied over rust—Rust-Oleum keeps your equipment looking better . . . LONGER!

Rust-Oleum is *exclusive*, incorporating a specially-processed fish oil base that penetrates rust to bare metal. It dries right, is free of objectionable odor, is ready-mixed and self-leveling. Specify genuine Rust-Oleum. Accept no substitutes. Many leading industrial oil field supply distributors carry complete stocks for your convenience.

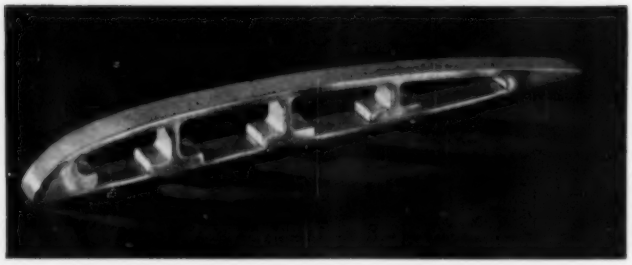


FOR FREE TEST SAMPLE—ATTACH TO YOUR LETTERHEAD AND MAIL TO: RUST-OLEUM CORPORATION 2638 OAKTON ST., EVANSTON, ILL.

Please Send Me a FREE TEST SAMPLE to Match the Following Color: (check sample desired)

- ☐ Test Sample of 769 Primer to be applied directly over rusted surface
- ☐ Test Sample of CATERPILLAR YELLOW
- ☐ Test Sample of NEW NATIONAL BLUE
- ☐ Test Sample of NEW UNIT RIG GRAY
- ☐ Test Sample of NEW EMSCO GREEN
- ☐ Test Sample of BETHLEHEM YELLOW
- ☐ Test Sample of WAUKESHA GRAY
- ☐ Test Sample of OIL WELL ORANGE
- ☐ Test Sample of OLD EMSCO GREEN
- ☐ Test Sample of READY-MIXED ALUMINUM
- ☐ Test Sample of HIGH GLOSS WHITE
- ☐ Test Sample of QUICK DRYING BLACK
- ☐ Nearest Source of Supply
- ☐ Complete Literature and Color Charts.

No. 38W and 48W. Other units available from ¾".



Cross section shows structural superiority of Aeromaster's new, extruded aluminum-alloy blades in diameters from 9' to 22'.

NEW! EXTRUDED ALUMINUM Blades on AEROMASTER* fans only

AEROMASTER'S new, extruded aluminum blades combine in one design the advantages of a light weight metal, a hollow structure and the superior strength of wrought metal... Silicon-magnesium aluminum alloys resist corrosion. Their fine grain structure, high tensile strength and increased endurance eliminate danger from wear, vibration, and metal fatigue... true airfoil blade sections assure maximum air delivery... adjustable blade pitch angle permits decrease of fan load to an accurate minimum horsepower requirement.

The AEROMASTER fan is easily assembled *in the tower*. No special handling equipment is necessary. AEROMASTER fans cost less to install, less to operate, less to maintain!

For more details write to KOPPERS COMPANY, INC., Aeromaster Fan Dept., 6703 Scott Street, Baltimore 3, Maryland.

KOPPERS

Aeromaster Fans

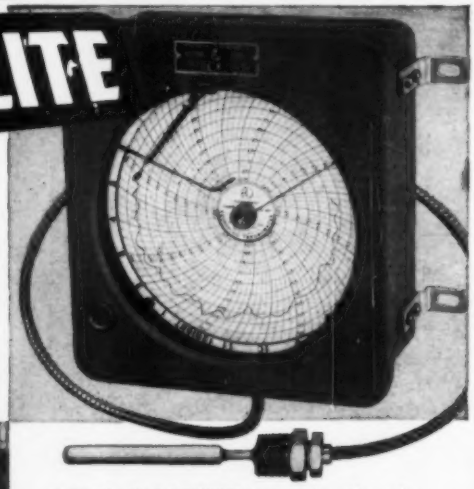
Engineered Products Sold with *Service*

*Koppers Trademark

AUTO-LITE

...for TEMPERATURE RECORDING...

One of the many uses for Auto-Lite Recorders is the application shown below... a natural gas field meter run.



Auto-Lite Model "1000" Temperature Recorder has 6" chart. Various standard ranges from minus 40° F to plus 550° F. Available for wall mounting, portable or portable self contained use. Electric or mechanical chart drive. Choice of 24-hr. or 7-day cycle. Capillary tubing permits remote reading. Priced as low as $49.50. Manufactured to customers' specifications. Send for latest Catalog describing many types of Auto-Lite Recorders and Indicators.

THE ELECTRIC AUTO-LITE COMPANY
INDUSTRIAL THERMOMETER DIVISION
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

TEMPERATURE RECORDERS & INDICATORS

Meetings

Feb. 12-14—National Association of Corrosion Engineers, Tulsa section, 9th annual Tulsa Corrosion Short Course for Pipeliners, Mayo Hotel, Tulsa, Oklahoma.

Feb. 13-15—National Society of Professional Engineers, spring meeting, Michigan State University, East Lansing, Michigan.

Feb. 16-20—AIME, annual meeting, Hotel Statler and Hotel Sheraton-McAlpin, New York City.

Feb. 26-28—American Petroleum Institute Division of Production, Southern district meeting, Shamrock-Hilton Hotel, Houston, Texas.

Feb. 28—Natural Gasoline Association of America, Permian Basin regional, Lincoln Hotel, Odessa, Texas.

Mar. 3-4—Society of Petroleum Engineers of AIME, 4th annual joint meeting of Rocky Mountain petroleum sections, Cosmopolitan Hotel, Denver, Colorado.

Mar. 5-6—Gas Conditioning, short course, sponsored by the schools of petroleum and gas engineering, The University of Oklahoma, Norman, Oklahoma.

Mar. 7-8—American Association of Petroleum Geologists, Pacific section annual meeting, Ambassador Hotel, Los Angeles, California.

Mar. 10-13—American Association of Petroleum Geologists — Society of Economic Paleontologists and Mineralogists, annual meeting, Biltmore Hotel, Los Angeles, California.

Mar. 12-14—API Division of Production, Southwestern district meeting, Hotel Texas, Fort Worth, Texas.

Mar. 17-21—National Association of Corrosion Engineers, 14th annual conference, Civic Auditorium, San Francisco, California.

Mar. 20-21—AIME, Petroleum Production and Reservoir Engineering conference, Mid-Continent local section, Mayo Hotel, Tulsa, Oklahoma.

Mar. 24-26—Midwest Gas Association meeting, Broadmoor Hotel, Colorado Springs, Colorado.

Mar. 31-Apr. 2—API Division of Transportation, annual pipeline conference, Jung Hotel, New Orleans, Louisiana.

Apr. 1-3—Corrosion Control, short course, sponsored by the Oklahoma City chapter of National Association of Corrosion Engineers and the College of Engineering, University of Oklahoma, Norman, Oklahoma.

Apr. 9-11—API Division of Production, Mid-Continent district meeting, Biltmore Hotel, Oklahoma City, Oklahoma.

Apr. 12-17—American Chemical Society, 133rd national meeting, San Francisco, California, including Pacific Chemical Exposition, Civic Center, Exhibition Hall, San Francisco, California.

Apr. 14-17—ASTM, Design Engineering Conference, International Amphitheatre, Chicago, Illinois.

Apr. 15-17—Southwestern Gas Measurement Short Course, University of Oklahoma, North Campus, Norman, Oklahoma.

Apr. 16-18—Natural Gasoline Association of America, annual convention, Baker and Adolphus hotels, Dallas, Texas.

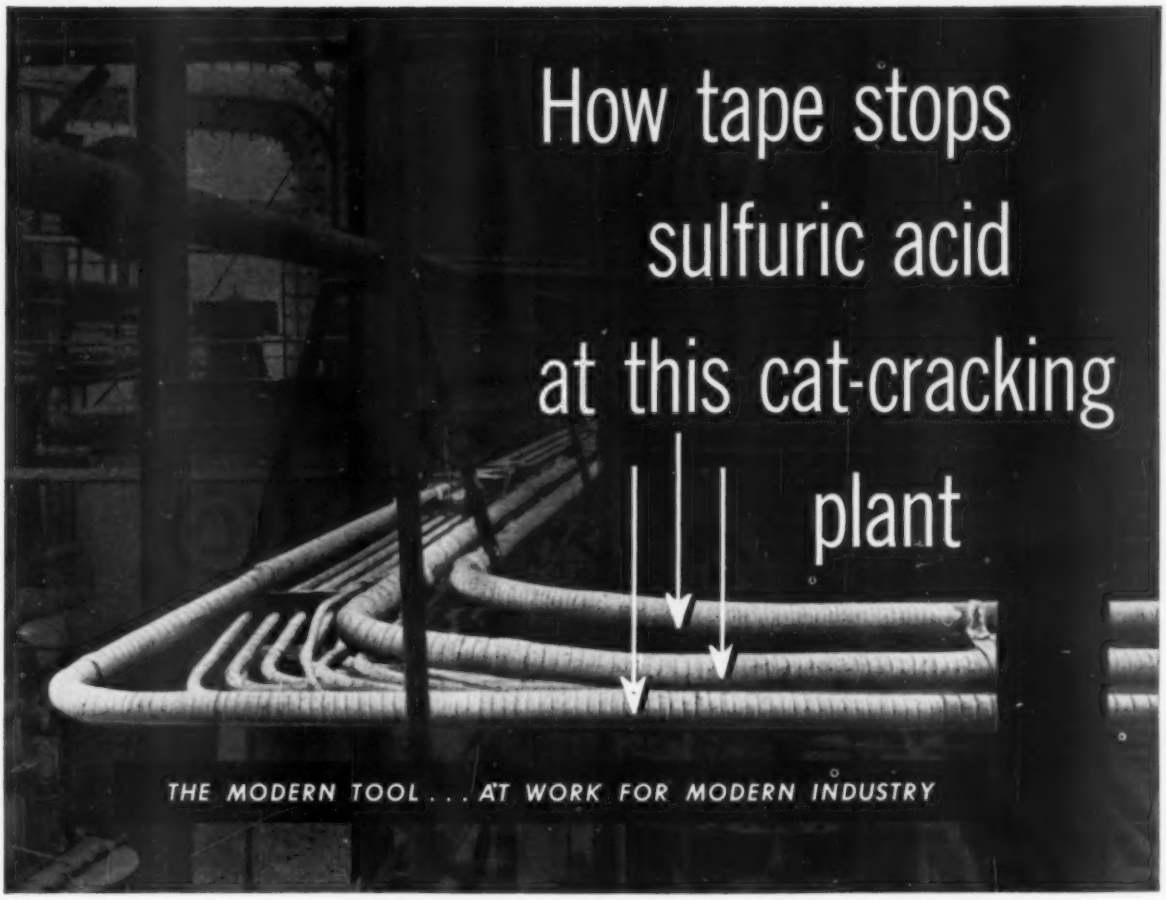
Apr. 17-18—Fifth Annual West Texas Oil Lifting Short Course, Texas Technological College, Lubbock, Texas.

Apr. 17-18—Geophysical Society of Tulsa and Tulsa Geological Society, 11th annual Midwestern Exploration Meeting, Tulsa, Oklahoma.

Apr. 17-18—Society of Petroleum Engineers of AIME, Louisiana, Arkansas, East Texas and Mississippi petroleum sections, gas technology symposium, Shreveport, Louisiana.

Apr. 20-23—American Institute of Chemical Engineers, regional meeting, Sheraton-Mt. Royal Hotel, Montreal, Canada.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



FIVE YEARS UNDER THESE HIGHLY CORROSIVE CONDITIONS PROVES THAT POLYKEN PROTECTION WORKS . . . *TO TRIM COSTS*

Look in on one of the world's largest fluid catalytic cracking units. A maze of conduit and pipe exposed to an extremely corrosive sulfuric acid atmosphere.

Formerly, these structures had to be painted every three or four months. Maintenance costs were excessive. Then, five years ago, they were wrapped with Polyken Protective Tape Coating. They have needed practically no attention since.

INERT POLYETHYLENE

The reason is that Polyken takes amazingly inert polyethylene and makes it into a tape coating with all these properties.

- **tough and elastic**
- **unplasticized, non-drying film**
- **doubly thick adhesive to seal all voids**
- **far higher adhesion for a true bond to pipe surface**
- **lower water vapor transmission rate**
- **higher electrical insulation resistance**
- **better cold weather handling and durability**

Check the savings. Contact the Polyken distributor in your area.

Atlanta, Georgia: Steele & Associates, Inc.
Chicago, Ill: Sales Engineering, Inc.
Cincinnati, Ohio: Hare Equipment
Cleveland, Ohio: The Harco Corp.
Des Moines, Ia.: The Donald Corp.
Fort Worth, Texas: Plastic Engineering & Sales Corp.
Harvey, La.: Allen Cathodic Protection Co.
Houston, Texas: Cathodic Protection Service.
Kansas City, Mo.: Industrial Coating's Engineering Co.
Long Beach, Calif.: Barnes & Delaney
Minneapolis, Minn.: Simcoe Equipment Co.
Oakland, Calif.: Bison Co.
Philadelphia, Pa.: Harold N. Davis Co.
Pittsburgh, Pa.: Royston Laboratories, Inc.
Plainfield, New Jersey: Stuart Steel Protection Corp.
St. Louis, Mo.: Shutt Process Equipment Corp.
San Francisco, Calif.: Aetna Sales Co.
Seattle, Wash.: Farwest Corrosion Control Corp.
Seattle, Wash.: Pacific Water Works Supply Co.
Tulsa, Okla.: William Cluff Corp.

Polyken®

Experienced in modern PROTECTIVE COATING

THE KENDALL COMPANY
Polyken Sales Division

Did You Ever See a Double Headed Pump?

This unusual installation is operated by Low-Cost Utility Electric Power

Pumping from different depths but through the same casing, these pumps can be operated simultaneously or singly. Each is operated by AUTOMATICALLY CONTROLLED push-button power – ELECTRIC POWER.

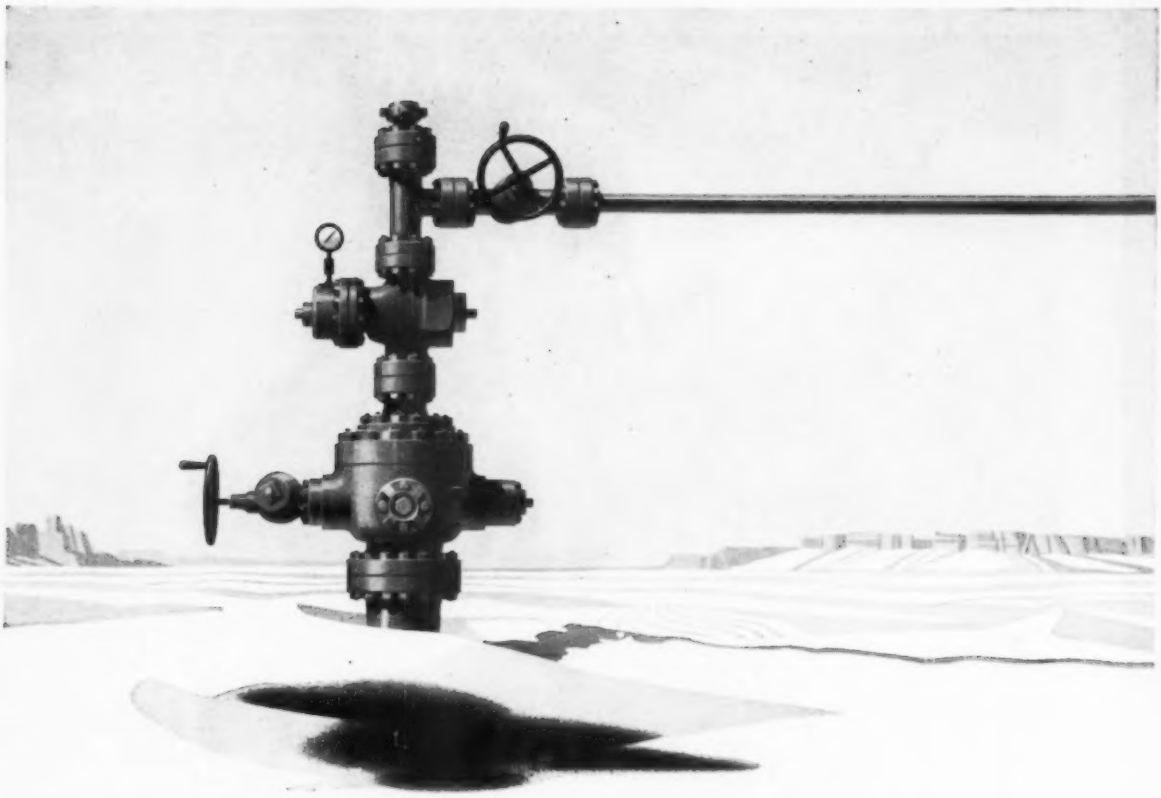
While such installations are not common, it is standard procedure in most fields today to utilize Utility Electric Power because of the overall LOWER COST, greater efficiency, and numerous special benefits.

For helpful counsel on how you can benefit, call the Power Engineer of your Utility Electric Service Company.

I'm LCP – Low-Cost Power
ON THE JOB – 24 HOURS DAILY.

PETROLEUM ELECTRIC POWER ASSOCIATION
P. O. BOX 35006 DALLAS, TEXAS

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



GLIDDEN NU-PON COTE LININGS

...the unseen sentinels that guard against pipeline failure and needless loss!

When you put a pipeline out of sight, you can put it out of mind also by lining it with Glidden NU-PON COTE*. These superior linings offer outstanding adhesion to iron, steel, aluminum, plastics, masonry and galvanized iron. And, they perform equally well on tank cars and storage tanks.

Glidden NU-PON COTE provides excellent parafine release plus maximum resistance to highly-corrosive sour crude, natural gas, chemicals, water and abrasion. In addition, it is particularly good in operating conditions involving the majority of concentrated solvents.

Besides NU-PON COTE, Glidden offers the VINYL-COTE*, VYN-AL* and NEV-A-RUST* maintenance coating systems, each specifically engineered to offer positive corrosion control at lowest cost per square foot per year.

*A Glidden Trade-Mark

Write today (company letterhead, please) for your copy of this new book which contains complete information on all Glidden Maintenance coatings.

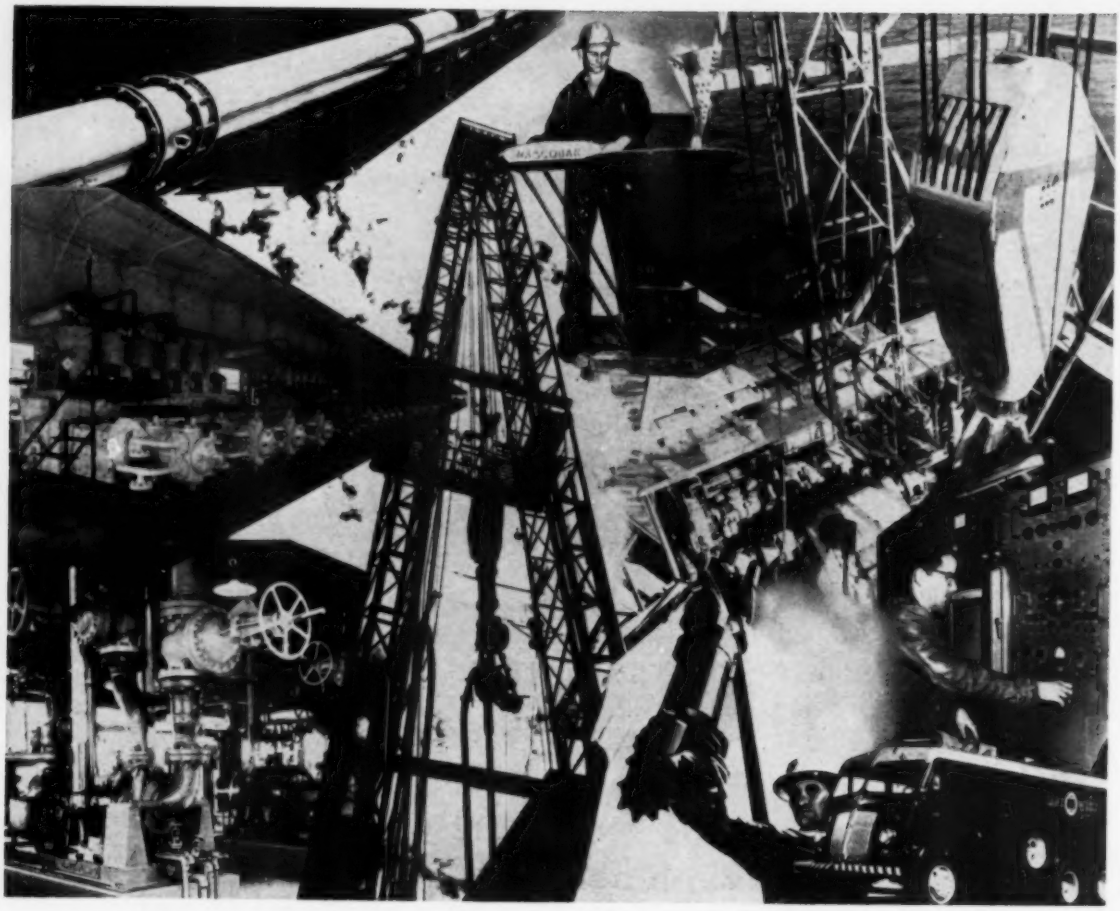
THE GLIDDEN COMPANY

INDUSTRIAL MAINTENANCE HEADQUARTERS

900 Union Commerce Bldg. • Cleveland 14, Ohio

QUALITY Glidden PRODUCTS

SALES OFFICES AND FACTORIES: San Francisco, Los Angeles, Chicago (Nubian Division—1855 North Leclaire Ave.), Minneapolis, St. Louis, New Orleans, Cleveland, Atlanta, Reading. In Canada: Toronto and Montreal.



Tomorrow's Progress Planned Today

ONE OF THE DRESSER INDUSTRIES

look for this symbol

...it identifies all Dresser Companies and their products

THE DRESSER INDUSTRIAL TEAM SERVES THE GROWING OIL

the Dresser Badges of Merit plus+

CLARK

CLARK BROS. CO., Olean, New York —Gas turbines, engines, and reciprocating, centrifugal and axial flow compressors—gas, steam, electric and diesel driven.

DRESSER IDECO

DRESSER-IDECO COMPANY, Columbus, Ohio—Radio and television broadcasting towers, steel buildings, aircraft hangars, electric power substations.

DRESSER MANUFACTURING DIVISION

DRESSER MANUFACTURING DIVISION, Bradford, Pa.—Pipe line couplings, pipe repair sleeves and clamps, weldments, forgings, welding fittings, flanges, rings.

GUIBERSON

THE GUIBERSON CORPORATION, Dallas, Tex.—Swabs, packers, anchors, workover equipment—drilling heads, blowout preventers, tubing blocks, hooks, swivels, kellys, savers, unions. Gas lift equipment. Molded rubber products.

IDECO

IDECO, Dallas, Tex.—Hydrair* and Power Rigs; Full-View* Masts; substructures; single, dual and Drive-In Rambler Rigs; blocks, swivels, rotaries; mud pumps; petroleum equipment and supplies.

LANE WELLS

LANE-WELLS CO., Los Angeles, Calif., Houston, Tex., Oklahoma City, Okla.—Electric and Radioactivity Well Logging, Koneshot* perforating and bullet perforating, packers and bridging plugs.

Magcobar.

MAGNET COVE BARIUM CORP., Houston, Tex.—Magcobar* and Magcogel* drilling muds and other specialized oil well drilling fluids and chemicals.

PACIFIC

PACIFIC PUMPS, INC., Huntington Park, Calif.—Centrifugal pumps for refineries, power stations, pipelines, and chemical plants; plunger pumps for oilwells.

ROOTS-CONNERSVILLE

ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind.—Rotary positive blowers, gas pumps, centrifugal blowers, exhausters, vacuum pumps, and positive displacement meters.

Security

SECURITY ENGINEERING DIVISION, Dallas, Tex., Whittier, Calif.—Rock bits, reamer rock bits and hole openers; reamers, casing scrapers and Neo-Red rubber stabilizers.

SIE.

SOUTHWESTERN INDUSTRIAL ELECTRONICS CO., Houston, Tex.—Seismograph systems and instruments—electronic, electro-mechanical. Computers—analog and digital; recording systems. Special transformers, reactors.

WELL SURVEYS

WELL SURVEYS, INC., Tulsa, Okla.—Nuclear and electronic research and development for the petroleum and other industries. Originators of radioactivity logging.

*Trademark registered

put this DRESSER *plus+* team to work for you!

You receive a bonus of extra value whenever you are served by any one of the Dresser companies. *Men with imagination* provide the research, engineering, manufacturing and service applications for the particular specialties of each Dresser operating unit. All Dresser companies work together with their combined experience and facilities to form the world-wide Dresser industrial team. This inter-company teamwork offers a bonus in greater experience and technical knowledge—backed by the extensive Dresser facilities—in the customer's specific industry. This intangible but important factor is known the world over as the Dresser plus+ . . . the mark of superior equipment and services for the oil, gas, chemical, electronic, and general industry.

Dresser's world-wide engineering experience in many industries plays a major role in the creation of new developments and improved technological methods. No other single company provides the same broad range of equipment and services. The Dresser plus + is a symbol for the superior quality of equipment and technical services which have become the standard of comparison in industries the world over!

DRESSER INDUSTRIES, INC.

EQUIPMENT AND TECHNICAL SERVICES

OIL • GAS
CHEMICAL
ELECTRONIC
INDUSTRIAL

POST OFFICE BOX 718 • REPUBLIC NATIONAL BANK BUILDING • DALLAS 21, TEXAS

GAS, CHEMICAL AND ELECTRONIC INDUSTRIES — EVERYWHERE

Dr. Julio Cesar Turbay, *Minister of Mines and Petroleum, is one of the bright young men of the Colombian government. He went from university to political office, beginning in the Assembly of Cundinamarca, the department in which Bogota, the capitol, is situated. He advanced step-by-step to President of House of Representatives for two terms; Colombian Ambassador to the General Assembly of the United Nations (1949), and last year, at the age of 40, he became head of the Ministry of Mines and Petroleum. He is also a national director of the Liberal party. In this interview he gives briefly a fact-filled background of Colombia's policy toward the petroleum industry.*

Why Colombia

An interview with

Dr. Julio Cesar Turbay Ayala

Minister of Mines and Petroleum

Q. **Which natural resources come under your department of the government?**

A. Natural resources under the jurisdiction of the Ministry are mines and petroleum. Mines include gold, silver, platinum, copper; emeralds, beryl, and other precious stones; deposits of iron, lead, mercury, coal, and deposits of rock salt.

Q. **Is petroleum a major part of your work?**

A. Of greatest importance to the Ministry is our work connected with concessions and operations of petroleum.

Q. **How many and what proportion of your staff devote their time to petroleum affairs?**

A. The technical personnel of the Ministry devote an equal proportion of their work to the mines and to petroleum.

Q. **Do you have a petroleum engineering division?**

A. The Ministry calls upon the National Division of Petroleum which has in its service a team of petroleum engineers who handle any questions that arise.

Q. **Have any of these been educated in engineering schools outside Colombia?**

A. More than half of the personnel in the petroleum engineering group have studied outside the country, most of them in the United States.

Q. **Which colleges or universities in Colombia give engineering and scientific degrees?**

A. The geology department of the National School of Mines at Medellin and the petroleum department of the Industrial University of Santander confer degrees in geology and petroleum engineering.

Q. **Do you consider the petroleum laws of Colombia equally profitable to the government and to private capital invested in oil?**

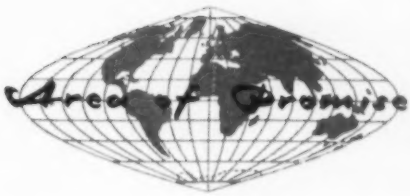
A. The latest reforms and additions to the petroleum laws, by conceding new economic and fiscal stimulus to the petroleum industry, tend to implant the system of 50-50 participation in the resources by the government and industry.

Q. **Do your petroleum laws favor Colombian capital over outside capital?**

A. The principle that inspired the laws governing foreign capital invested in the development of natural resources and the industry in general, grants to foreign capital the same treatment as that given to national capital.

Q. **Have recent changes in the petroleum laws increased oil activities?**

A. The increased interest that has recently been shown by the oil companies in the exploration for new petroleum sources can certainly be attributed to the recent changes in the petroleum laws.



Attracts Oil Companies

NEW LAWS ACT AS STIMULUS... NATION RESPECTS PRIVATE ENTERPRISE... PETROLEUM COMPANIES TRAIN EMPLOYEES AND AWARD SCHOLARSHIPS... DEPARTMENT OF CONSERVATION OF OIL AND GAS SET UP TO INVESTIGATE METHODS AND DETERMINE BEST PRACTICES... CONSUMPTION HAS INCREASED ABOUT 8 PERCENT A YEAR... DOMESTIC REFINERIES NOW MEET DEMAND...

Q. **I understand the new depletion allowance has increased investment in Colombian oil. Will you explain this?**

A. The depletion allowance, among other incentives granted to the industry, has greatly influenced proposed investments since it allows the companies larger resources for their future investment programs.

Q. **Are your people benefited by operations of oil companies?**

A. There is no question that the oil companies have contributed to our national well being.

Q. **Do the people, themselves, feel that oil operations are good for the country?**

A. I believe Colombians in general are pleased with our relations with oil companies operating here.

Q. **Have oil companies helped in any way to educate more engineers and scientists?**

A. Yes, by awarding some scholarships and by direct training of Colombian personnel.

Q. **Do they have adequate on-the-job training?**

A. Some very good programs have been set up by the petroleum industry to train and advance employees.

Q. **What percentage of Colombians must make up personnel in an oil company?**

A. The law does not establish a fixed percentage, but it is the obligation of the industry to give equal treatment to both Colombian personnel and foreign personnel.

Q. **Have you established any Colombian oil research organizations or do you have plans for any?**

A. The law has created the Department of Conservation of Petroleum and Gas, which will be a body devoted to technical investigation (research) and to the application of practices and methods to the sound exploitation of hydrocarbon resources.

Q. **You have a new modern refinery that is said to be one of the world's finest. Will this change your oil export-import picture?**

A. The Barrancabermeja refinery already provides 65 percent of the present needs of the country.* With the new refinery no petroleum products will need to be imported.

Q. **What has been the change in consumption of oil products in Colombia in the past?**

A. During the past five years, there has been an average annual increase of 8 percent in the consumption of oil.

Q. **What do you predict for the future?**

A. Counting on the refinery at Cartagena, the balance of national consumption will be provided, but it is estimated that by 1961-65 expansion of the refineries will be necessary in order to keep up with the increased demand for refined products. Colombia population is one of the fastest growing in the Western Hemisphere and strides are being made in modern business and industry which means greater need for petroleum products.

*Capacity is 36,500 bbl a day.

Area of Promise

The range of Colombia's life and land must be seen to be believed. In this traditional square is Bogota's beautiful modern hotel, Tequendama. Across from it is an ancient Catholic church in simple mission architecture. Farther to the right but not shown is the big bright bullfight ring. You have only to turn your head to choose an age and a style.
—Courtesy Colombian Government

Rivers are the highways of Colombia. On opposite page is a typical Mississippi-type pusher tug used on the Magdalena River. It carries passengers and pushes one barge. It does the La Dorada to Barranquilla trip of some 500 miles in 3 to 4 days and the return, upstream, in 4 to 5 days.
—Courtesy Shell Condor, S. A.

Fortune Beckons From Colombia

Ernestine Adams

WITH THE GENTLE reign of political peace and the steady light of economic health, Colombia could "burst out all over" with blooms of progress.

The country has intelligent and resourceful people; some of the most highly educated and cultured individuals in Latin America are among its 13 to 14 million inhabitants. Its lands are broad — it is larger than Texas, New Mexico, and Louisiana combined — and its situation is strategic, bordering two oceans and five nations. Its capital, beautiful Bogota , sitting 8660 ft high in the Andes, has been called "the Athens of South America."

The resources are there — treasure buried and concealed by a cunning and uncaring nature, preening herself with ice-capped mountains on the Equator.

Nature has never stopped man — though she might deter him — but other men can. Despite a free economy, political Colombia often throws business and industry into helpless confusion with its physical clashes and fiscal disorders.

Demanding loyalties and unconceding patriotism of Colombians trick them into political controversy that defeats progress and invites chaos and even death. It is said that 200,000 persons have died in the political battles of the last few years. Nobody, of course, has won this undeclared civil war.

Today there is hope of peace and development. A sound majority has voted to declare a political truce for 12 years. The Army-Navy Junta that took over in May 1957, has done a superhuman job with patience and finesse. Colombia has established a path to advancement; it remains to be seen whether she will make it a broad highway to great achievement.

Miss Adams is management editor.

History and Politics

The Spanish first discovered Colombian territory in 1499 when Alonso de Ojeda visited Cape Vela. It was not until his fourth voyage in 1502 that Columbus attempted to explore the mainland. The great explorers pushed up the rivers of Colombia, suppressing and enslaving the Indians and setting up and establishing settlements along the rivers or near the mountain passes.

One of the most curious coincidences in history is the meeting of three conquistadores at Bacata. Gonzalo Jiménez de Quesada in 1536 left Cartagena at the head of some 700 foot soldiers and 80 horsemen. He was two years making his way across mountain ranges and difficult streams, fighting fierce native tribes along the way, before he reached Sabanas around about Tunja with 164 men left. He made his headquarters at the conquered town of Bacata and called it Santa Fe de Bogota.

Hardly had he settled down when he was startled by two more white invaders coming from opposite directions. Nicholas Federmann, a German who had been sent by the Governor of the Province of Venezuela, had taken three years to come almost due south from Cape Vela, crossing high ranges of mountains. From the opposite direction came Sebastian de Belalcazar, who had seized the Kingdom of Quito and from there marched to Bogota. This must have been the original "It's a small world" incident.

The three explorers finally reached terms, organized an administration, and returned to the coast to sail for

THERE ARE HINTS AND GLIMPSES OF EARTH'S FAIR TREASURE IN THE LANDS OF NEW GRANADA. . . . ITS COFFEE AND EMERALDS TOP THE MARKETS OF THE WORLD. . . . ITS PETROLEUM IN RECENT YEARS HAS SERVED THE NATION WITH ENERGY AND DOLLARS

Spain. By the middle of the 16th Century Spanish dominion was firmly established in the new Kingdom of Granada, but the natives were almost exterminated as the result of forced labor and of disease. To provide labor, black slaves were imported from Africa and today have nearly three million descendants.

As in other Spanish colonies, all power was held by office holders from Spain and by the ecclesiastical orders. Dissatisfaction bred revolutions and on July 20, 1810 a proclamation of independence was declared at Bogota. Not until nine years later was the imperial power finally broken by Simon Bolivar, who was elected president. He first formed a confederation, including Venezuela, Colombia, and Ecuador, which was broken up in 1830 when Venezuela declared itself free.

Turmoil and struggle have followed the history of Colombia with occasional stretches of peace and development that provide a glimpse of Colombia's potential.

More recently Colombia made the headlines when riots broke out in April 1948, at the time of the Ninth Inter-American Conference in Bogota. Mariano Ospina-Perez, president, tried to rule by coalition but internal wrangling spread and all liberal members resigned in March 1948.

Laureano Gomez followed Ospina. He was a strong man, but he had difficulty in pacifying the storm centers of opposition. Lt. Gen. Gustavo Rojas Pinilla overthrew Gomez in 1953 and brought an end to civil war. Rojas began as a reformer and ended by suppressing newspapers, spending the money from coffee exports for arms and luxuries, and collecting a personal fortune. Some say he salted away $10 million. There was one estimate that his administration had cost the nation $5 billion.

He ordered his legislation to invalidate a provision that forbade a president to succeed himself so he could be president four years more. Again rioting broke out. Businessmen and bankers and the church combined to oust him. Finally Rojas left for Spain and exile.

A five-man military Junta headed by Major General Gabriel Paris, took over May 10, 1957, and has been governing the country since. The Junta slashed military expense, freed imports and exports from many controls, and set up a plan for settling debts to foreign suppliers.

Liberal ex-President Alberto Lieras Camargo and Conservative ex-President Laureano Gomez are reported to have conferred last summer and proposed an election, which was held in December. The proposal, passed by an overwhelming majority vote, was that each party should have equal share in political power for the next 12 years. The military is to step out in August of this year when a civilian president will be inaugurated. The provision for equal shares in government for the three terms extends to cabinet posts, congressional seats, state legislation, and even town councils. Every department will be on a 50-50 Liberal-Conservative basis.

In commenting on the election, the Dallas Morning News said "If the Army-Navy Junta now in power can persuade the country to decree a truce between the ins and outs of politics, it will have accomplished a miracle. And if the miracle works, Colombia will

Gift building in Cali, Colombia, was presented by a good neighbor, Venezuela. It required the sum of more than $1 million to construct the apartment for workers who lost their homes in a tragedy caused by the explosion of trucks carrying dynamite. —*Courtesy Braniff Airways*

enter upon an era of miraculous prosperity. Its resources are literally invaluable."

Geography

The only country in South America with a coast on both oceans, Colombia has two almost equal parts of totally dissimilar areas. From its great knot in the south, the Andean Mountain range branches into the Eastern, Central, and Western Cordilleras. About 41 percent of the country, this territory of mountains, uplands, and valleys, contains almost all the population.

Isolated from the three Cordilleras is the Sierra Nevada de Santa Marta, which rises from the sea to a height of 19,623 ft between the Goajira Peninsula on the Caribbean Coast and the mouth of the river Magdalena.

The other 59 percent is the Oriente — eastern flat lands — still much as it was when the Spaniards came to Colombia four centuries ago. Roughly the north half, known as the Llanos, consists mainly of grass plains, and the southern part is Amazonian jungle. The Eastern Cordillera of the Andes is the longest of the three and it divides the Llanos from the valley of the Magdalena. It encloses the Sabana, the level plateau on which is built the country's capital, Bogota.

The vast plains country, east of the mountains, is used for cattle raising. The heavy jungle in the south is mostly unexplored.

The region forms part of the Amazon and Orinoco basins and air travel today is the main method of transportation. There are several airports and innumerable grass landing strips. Surface transport is still largely by horse or by launch and canoe on the rivers as roads are virtually nonexistent. It is hard to predict whether this region can ever be developed into a rich, productive area as so many believe. Evidence today is too sketchy to make forecasts.

The Colombian divides his country into hot country, temperate country, and cold country. The type climate is determined by the elevation above sea level, not by seasons.

Resources

Natural resources of Colombia are vast and varied. The land is fertile and will grow almost anything. Cities hacked out of jungles have an eternal struggle to hold back the lush growth of rich lands.

Farms grow rice, sugar cane, cotton, bananas, tobacco, coconuts in the Tropics; coffee, which accounts for 85 percent of Colombia's exports,[1] maize, beans, plantains in temperate altitudes; wheat, potatoes, peaches, apples, cherries in high levels.

Only Colombia in all the world mines emeralds of great beauty and brilliance. There are some mines in Russia but they do not produce gems of the same high quality.

Four centuries ago the Spanish discovered the Indians offering their gods emeralds and gold in their temples. The same mines the Indians worked so long ago are mined today.

The most famous emeralds in the world are from Muzo — brilliant green stones more fragile than diamonds, and often more costly. The Muzo,[2] Coscuez, and Chivor mines are operated by the Banco de la Republica for the government.

An estimated $1 billion worth of gold has been marketed from the mines of Colombia since the 16th century. The country produces more gold than any country in South America — some 400,000 troy ounces a year. Banco de la Republica in Bogota contains a collection of gold work which includes vessels and ornaments and statues of the pre-conquest period.

Enough platinum is produced in the gold mines to give Colombia fifth standing in platinum production in the world.

Silver is found in the gold mines as another sub-product and there are also mines of silver only. Production runs about 115,000 troy ounces a year.

The great deposits of iron ore in the department of Boyaca supply the new Acerias Paz de Rio steel mill. The mill, opened October 1954, has a capacity of 80,000 tons of steel.

Her great salt mines are another important resource of Colombia. In the solid salt mountains at Zipaquira and Nemocon are huge halls and galleries and in one is a cathedral, all with walls of gray salt.

There are large coal deposits, clay, gravel, copper and lead, and mercury. Colombia exported her first coal in 1957. This shipment went to France, and Argentina is now negotiating for some 70,000 tons. Reserves are estimated at 400 million tons.

There are many first class cement plants in the country. A French firm recently contracted to build another cement plant in Bucaramanga. A barites mine and mill produce a good quality mud-weighting material. Locally manufactured "mangle," similar to "quebracho" is available for mud treatment.

Oil Discovery

There is also oil. Production is second only to Venezuela in South America, although there is a wide margin between Venezuela's 2½ to 3 million bbl a day and Colombia's 130,000 bbl.

America's great wildcatter Michael L. Benedum, of Pittsburgh, found Colombia's first oil. We'll let him tell what happened back in 1915 when a Benedum drilling crew penetrated the Colombian jungle, where even mules found it tough going.

"Once in a while our own imaginations were almost too big for us. Who,

[1] Colombia is first in the world in production of mild coffee. Second in the world in production of all types of coffee.

[2] One flawless Muzo emerald weighed 1225 karats. It was bought by the Duke of Devonshire and is known as the "Devonshire Emerald."

for instance, had ever drilled in the jungles of Colombia? Who would be willing to enter those distant wilds, seek oil, and — if by chance he made a strike — transport it over the torturous miles through undeveloped country to a seaport? Such a venture, we realized at the time — this was 1915 — meant a huge undertaking that would tax our resources to the utmost. Yet our dreams kept prodding us on.

"This is how the Colombian venture came about. We had just struck a lot of oil in the Tuxpam field in Mexico, sold our interests in the field, and were more or less unoccupied with immediate problems when an associate in the Mexican venture, John Leonard, stirred us up again. John was taking a deserved vacation, cruising off the coast of South America. Oil was the thing furthest from his mind, and it was by sheer coincidence that he met a geologist friend aboard ship. A third passenger, Robert De Mares, overheard their oil conversation and joined them. De Mares claimed he had an oil concession from the Colombian government — three million acres.[3]

"Such talk excited John Leonard. He and his geologist friend accompanied De Mares into the Colombian jungles to inspect the huge lease, called the Infantas. Once there, John became much more excited. The land smelled of oil, seeped oil everywhere. In some areas, due to floods, the trees were splattered with crude to a height of 20 ft!

"De Mares needed financial support in order to develop his lease. John Leonard suggested Joe Trees and me, and in a short time Joe and I were surrounded by atlases and maps of this little-known country at the northwestern neck of South America. Indeed, the Infantas posed a great challenge. Towering mountains and a river only partly navigable were obstacles as great as the trackless jungle itself. Nor was geography the only major problem.

"Where would we get skilled laborers? How would we house them and safeguard their health? How would we establish communications? How could we transport heavy equipment to the fields, and how could we get the crude to market? What about the head-hunters of the region? The poisonous snakes and boa constrictors?

"These and other problems plagued us. But the three-million-acre concession drew us like a magnet (later we found that De Mares had one million acres— ample enough).

"A great deal of planning went into the Colombian venture. It was nearly a year before things really started moving. One by one, the obstacles were overcome; one by one, the problems were solved. As an illustration of the adaptability of everyone concerned, the drilling crews we brought into the jungle were at first terrified of being attacked by snakes, and yet before long they had a pet boa constrictor that they picked up and carried around the camp!

"As the Tuxpam field in Mexico had justified our confidence in it, so the Infantas fields fulfilled our every expectation. For many years, the De Mares lease produced 54,000 barrels a day. What's more, it drew serious attention to South America as a major source of petroleum."[4]

The Benedum-Trees subsidiary, Tropical Oil Company, was sold to International Petroleum (an affiliate of Jersey Standard, with headquarters in Coral Gables, Florida) back in 1920.[5]

About the same time of the De Mares Concession contract (1905) General Virgilio Barco gained what is known as the Barco Concession in the jungles near the Venezuelan frontier, where he had found oil seeps. This concession also covered a million-acre tract. The Barco Concession went through a checkered career until 1934 when Socony and Texas jointly purchased it and established the Colombian Petroleum Company.

Colpet developed the concession and constructed a pipeline over a fantastic terrain from Barco to Covenas on the coast of the Caribbean Sea between Panama and Cartagena. The line, built in one incredible year, went from steamy swamps through matted jungle atop the Andes and down to the sea.[6]

Lovely, historic Cartagena is on three inter-connected islands on the Caribbean coast. It has a population of some 200,000 people who have spread beyond the old walled city that battled pirates 300 years ago. This is near the Andian pipeline terminal; is site of the new Intercol refinery. *—Photo by Jack Ripper, courtesy Loffland Bros.*

Petroleum Operations

There is absolutely nothing safe and consistent about Colombia oil operations.

[3] The DeMares Concession is in the middle Magdalena Basin.

[4] Taken from "Wildcatting Is Still Wild," by Michael L. Benedum, American Petroleum Institute Quarterly, Autumn, 1957.

[5] "The De Mares Concession," David Donoghue, *The Petroleum Engineer*, March, 1951, Page A-39.

[6] Kathleen Romoli's account of this in "Colombia, Gateway to South America" is a thrilling saga of pipeline builders. Unfortunately this book is out of print. It is the best one on Colombia we've read and well worth a trip to the library. (Doubleday, Doran & Company, Garden City, New York, 1943.)

COLOMBIA

Oil operations have generally followed the Magdalena River. This shows the Western, Central and Eastern Cordilleras, which with the Pacific Coast comprise 41 percent of the land. The great eastern plains and jungle are almost unexplored.

How would you like to choose a drilling site to find oil sand that had been scattered by a trio of rising mountain ranges and wrapped in three-mile thick sediment?

The Standard Oiler[7] tells it this way: "Once upon a time, the western half of Colombia was an ocean bottom; larded with the decaying marine life that becomes petroleum. Then the Andes sprouted into three ranges, and tipped the ocean off the land. Other sediments covered the old sea bottom, to depths of as much as 20,000 ft. An icing of rich topsoil grew, as the tropical sun and frequent rainy seasons made a greenhouse of the land."

How would you like to drill a well with a steel mesh screen around the rig to protect you from the Motilone Indian arrows? Steel screen is the latest in rig equipment in the Rio de Oro field of Colombia Petroleum. These Indians don't like invaders and they are emphatic about it in their only means of communication — arrow shooting.

How would you like to spend $2 million on a well that went 13,107 ft through practically nothing except soft sticky shale? That is what Socony Mobil Oil of Colombia did at the Chagui wildcat near Tumaco on the West Coast. The photo explains some costs.

Slowly methods are improving. Helicopters and airplanes aid in exploration, pipeline construction and maintenance, and bring in supplies. Tractractors, called Bombardiers, are taking the place of mules in the eastern plains, about the size of Texas. Intercol has used these successfully.

Gas drilling was used for the first time in 1956. There have been times in the past when drilling mud disappeared completely from the hole during drilling operations.

The most amazing part of the whole picture is how companies have stuck it out with such limited success.

Socony Mobil went into Colombia in 1934 and has spent more than $30 million looking for oil. Only reward was discovery of Cantagallo in 1943, a small field sold to Shell in 1951. After considerable exploration, including drilling 53 wildcats, the company is heavily in the red in Colombia. Recently it re-evaluated its Colombian acreage and dropped that in the middle Magdalena Valley and the southwestern coastal acreage. This latter decision was based on findings of the Chagui dry hole.

It now has 2 million acres in the Llanos for another try, plus a half interest with Intercol on a 2,200,000-acre block in the Sinu area in northwest Colombia.

Socony Mobil is ready to begin a seismic program in the Llanos, and, with Intercol, is drilling a wildcat well, Cordoba No. 1, in the jointly held Sinu block. One-third of this block has been farmed out to the Sun group (Sun, Pure, United Carbon) in return for their drilling 18,000 ft of hole on the acreage.

Socony-Mobil, however, owns a half interest (along with Texas) in the Colombian Petroleum Company, which is just now on the verge of paying out the original investment in the Barco Concession after 24 years.

Richmond Petroleum (Standard of California) began operations in Colombia in 1921 and drilled 28 dry wells before Chinu No. 1 found considerable gas production. But Chinu is up in the northwest with few if any customers around. Last year the company drilled six more wells.

So far return on Richmond's $30 million invested in Colombia is information but Ygnacio Bonillas, who spent many years in Colombia as Richmond's manager,[8] has strong faith in the country's potential and the coming breakthrough to black ink in the accounts.

Shell has drilled over 50 exploratory wells, discovered Casabe, a major field, and El Dificil, a very small one, and is developing Yarigui, an extension of the Cantagello field.

The company went into Colombia in 1936. In spite of having sold 120 million bbl of oil with value of 600 million pesos, the company did not begin to recoup any of its investment until 1956, after 20 years of operations. During this time the national government received 133 million pesos from the company.

Until after the petroleum laws were revised in 1955, there was fairly steady progress in petroleum operations but no all-out concentrated program.

Since then operations have become

TABLE 1. Concessions, Oilfields, and Refineries in Colombia.

Company	Concessions total acres	Fields (Discovery)	Production[1] B/D	No. Wells Producing	Depth ft	Refineries	Capacity B/D
Shell	9,355,167	Casabe (1941)	30,829	376	2140–5660	None	
		Yarigui (1954)	4,447	4	7190–8028		
		Cantagello (1943)	2,603	9	4525–7358		
		El Dificil (1943)	1,435	15	5590–5800		
		Total	39,314	404			
Ecopetrol	2,173,600	La Cira (1925)	18,350	751	900–4200	Barranca-bermeja	36,500
		Infantas (1918)	7,600	328	600–3500		
		Galan (1945)	2,950	40	3000–4000		
		Colorado (1925)	430	14	2800–5600		
		Total	29,330	1133			
Colpet[2]	3,659,351	Tibu	18,979	243	4500–9700	Tibu	2 000
		Rio de Oro (1937)	3,134	23	1200–7900		
		Sardinata (1941)	1,368	20	4460–9700		
		Cicuco (1956)	4,380	8	8115		
		Petrolea (1933)	124	21	760–1220		
		Carbonera (1939)	38		800–1990		
		Total	28 030	315			
Texas	8,927,230	Velasquez (1946)	23,428	96	7000	Guamo	1,200
		Palagua (1954)	7,548	63	5774		
		Ortega (1951)	1,189	6	5800		
		Er... tana (1954)	522	4	5719		
		Tetuan (1949)	110	1	2696		
		Total	32,797	170			
International	26.458,000	Totumal (1951)	141	2	8872	Cartagena	26,500
		Buturama (1953)	84	3	6567		
		Gualanday	85	1			
		Total	310	6			
Richmond	5,891,293	Chinu (1956) (Shut in gas)					
Socony Mobil	3,472,017	None					
Cities Service[3]	3,244,566	None					

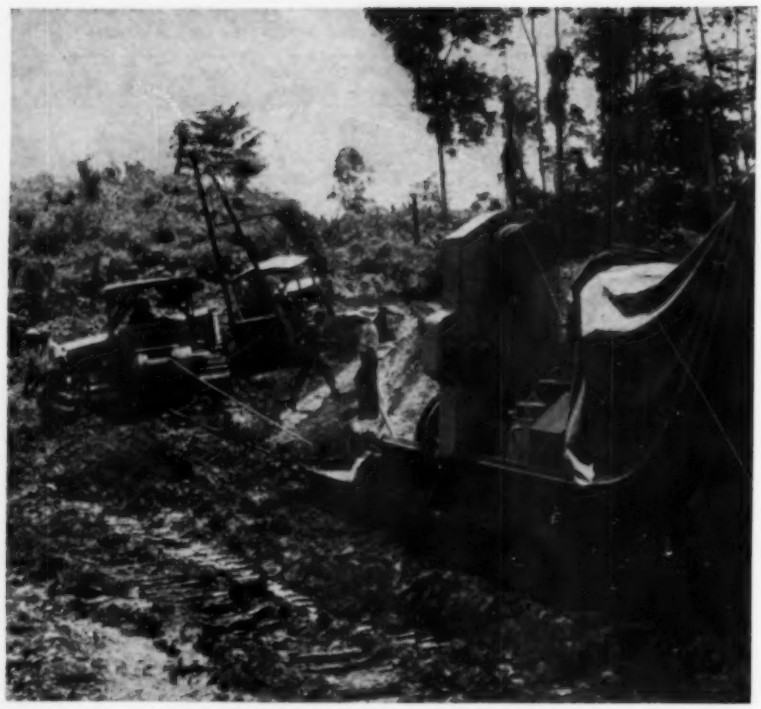
[1] Does not include natural gasoline.

[2] Owned 50-50 by Socony Mobil and The Texas Company.

[3] Colombian Cities Service made a partnership contract with Ecopetrol (75-25%) covering El Carare and nearby lands. Profits will be divided 75% to Cities Service and 25% to Ecopetrol. Ecopetrol made the same arrangement with John Mecom, Houston Independent, covering an offshore area in Tolu Bay and Morrisquillo Gulf on the Caribbean.

[7] Company magazine of Standard of California February, 1957; William H. Jones, editor.

[8] Mr. Bonillas recently went to San Francisco to be exploration consultant for Western Hemisphere for Standard of California. James L. Fox is new manager in Colombia.



This explains some costs. Two Caterpillar tractors inch by winch the heavy drawworks over a mud road to the well site. It took two and a half days to move this heaviest piece of equipment the 1½ miles from the Chaqui River bank to the site of Socony Mobil's wildcat in southern Colombia. —Courtesy Socony Mobil

more active. Besides International, Shell, Socony, Texas, Richmond, and their combinations, which held the older concessions, now came Sun, Pure, United Carbon, Cities Service, Pan American, Delta Colombian, John Mecom, An-Son Petroleum, San Jacinto Oil, and others.

In 1951 the De Mares Concession reverted to the government and Empresa Colombiana de Petroleos (Ecopetrol), the government company, took over. International (Tropical) continues to handle operations.

Ecopetrol operates on an equal basis with private companies and numbers some of Colombia's top oil men as its officers. Marco Aurelio Arango is president and Gonzalo Acosta is vice president. Ecopetrol controls the De Mares production and the Barrancabermeja refinery. This year the company surplus went to meet government debts.

Michael Benedum, Colombia's first successful wildcatter, has just entered into an agreement with Ecopetrol covering 700,000 acres in the middle Magdalena Valley, and it may extend over another 200,000 acres. The contract is to be signed this month (February). The area lies halfway between the Infantas Concession and the mouth of the Magdalena River. Mr. Benedum expects to begin drilling operations there about April 1.

In January Dr. Victor Oppenheim, partner in the Dallas petroleum consultant firm of Oppenheim and Briscoe, transferred a 40,000-acre concession to Ambassador Oil Corporation, Fort Worth, and drilling plans have progressed.

The Ministry of Mines and Petroleum, which handles all concessions and inspects all operations is headed by Dr. Julio Cesar Turbay, Minister, who is also chairman of the board of Ecopetrol. Colombia is an official observer of the Interstate Oil Compact Commission.

Economics

Only the most optimistic and unrealistic observers expected Colombia to clear up her economic problems quickly and easily after Rojas was thrown from power. She had immediately received an $87 million loan from U. S. Export-Import Bank and some private banks, and $25 million from International Monetary fund, but that also meant more to repay.

It is promising to know that payments are continuing on the backlog of commercial debt owed U. S. exporters and a beginning has been made in paying off the U. S. loan.

The United States is Colombia's best customer and largest supplier. In the first months of 1957 the U. S. supplied 58.2 percent of Colombia's imports and received 73.7 percent of her exports — mostly coffee, some petroleum and gold.

U. S. exports to Colombia were sharply reduced from 1956. In the first half of 1957, they totaled $92 million, down 49 percent. In an effort to cut overdue commercial balance the Colombian government restricted imports and probably will continue to do so.

On June 19, 1957, freedom of trading in foreign exchange was restored in Colombia for the first time in 25 years. A Junta decree abolished the fixed rate of exchange (2.50 pesos/$1) and the complex multiple-currency system.

Depending on the multiple import classifications, foreign exchange transactions were made at various percentages of free pesos and official pesos. Now capital imports for petroleum exploration and production, as well as other extractive industries, are made through a semi-free market (4.85-5.15 pesos/$1) and all other capital imports are made through the free market, (6.15 pesos/$1 on January 16, 1957).

The prohibited import list is very large and includes automobiles. Under the present system, all imports are subject to a uniform import tax of 10 percent.

Time required for import licenses and for receipt of replacement parts and supplies in the oil industry is about six months. Since almost everything must be imported, this requires a close check to be certain that ample supplies are always available.

Colombia actively encourages foreign capital. The favorable climate and rapid expansion in recent years has encouraged investment by outsiders. Chief among these are the oil companies.

The two principal refineries — Ecopetrol's at Barrancabermeja, and Intercol's new one at Cartagena — can process 63,000 bbl a day, about 20,000 bbl a day more than consumption. This is a great saving to Colombian economy. Most South American countries have to spend their exchange on oil products.

Petroleum products consumption is always a good index to modern progress. By this measurement Colombia marches forward. Dr. Turbay, Minister of Mines and Petroleum, estimates oil consumption has increased at an average of 8 percent a year for several years.[9]

Today people of Colombia are modernizing their cities, building highways, constructing schools and hospitals. Although the economy is picking its way out of a morass of debt and legal complexities, there is no reason it cannot make excellent strides with earnest effort. ★ ★ ★

[9] See interview, Page A-24.

for plants of distinction

look to Blaw-Knox

Regardless of the size or scope of your next project, the selection of the engineer-contractor remains a most critical decision. Pace setting projects provide one of the best proofs of the quality of creative resources and the extent of construction experience.

In offering a complete service that ranges from preliminary surveys, engineering and procurement to construction and initial operation, Blaw-Knox qualifications consistently meet the processing industry's most rigid requirements.

To see how this background can help your plans for process development, plant erection or modernization, contact our engineers for a preliminary discussion.

BLAW-KNOX

BLAW-KNOX COMPANY

Chemical Plants Division • Pittsburgh 22, Pa. • Chicago 1, Ill.

Birmingham • New York • Haddon Heights, N.J. • San Francisco • Washington, D.C.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

SOLUTION OF HAZEN AND WILLIAMS FORMULA FOR LARGE CAPACITY LINES

FORMULA:—

$$p^{0.54} = \frac{162.04\ Q\ g^{0.54}}{cd^{2.63}}$$

Where
P = Pounds per sq. in. friction loss per mile
Q = Discharge in bbls. per hour
g = Specific gravity
d = Inside diameter of pipe in inches

Examples:.

(1) Given: To transport 20,000 Bbls. of 60° Be' gravity gasoline thru 8" line pipe having a roughness coefficient C = 145

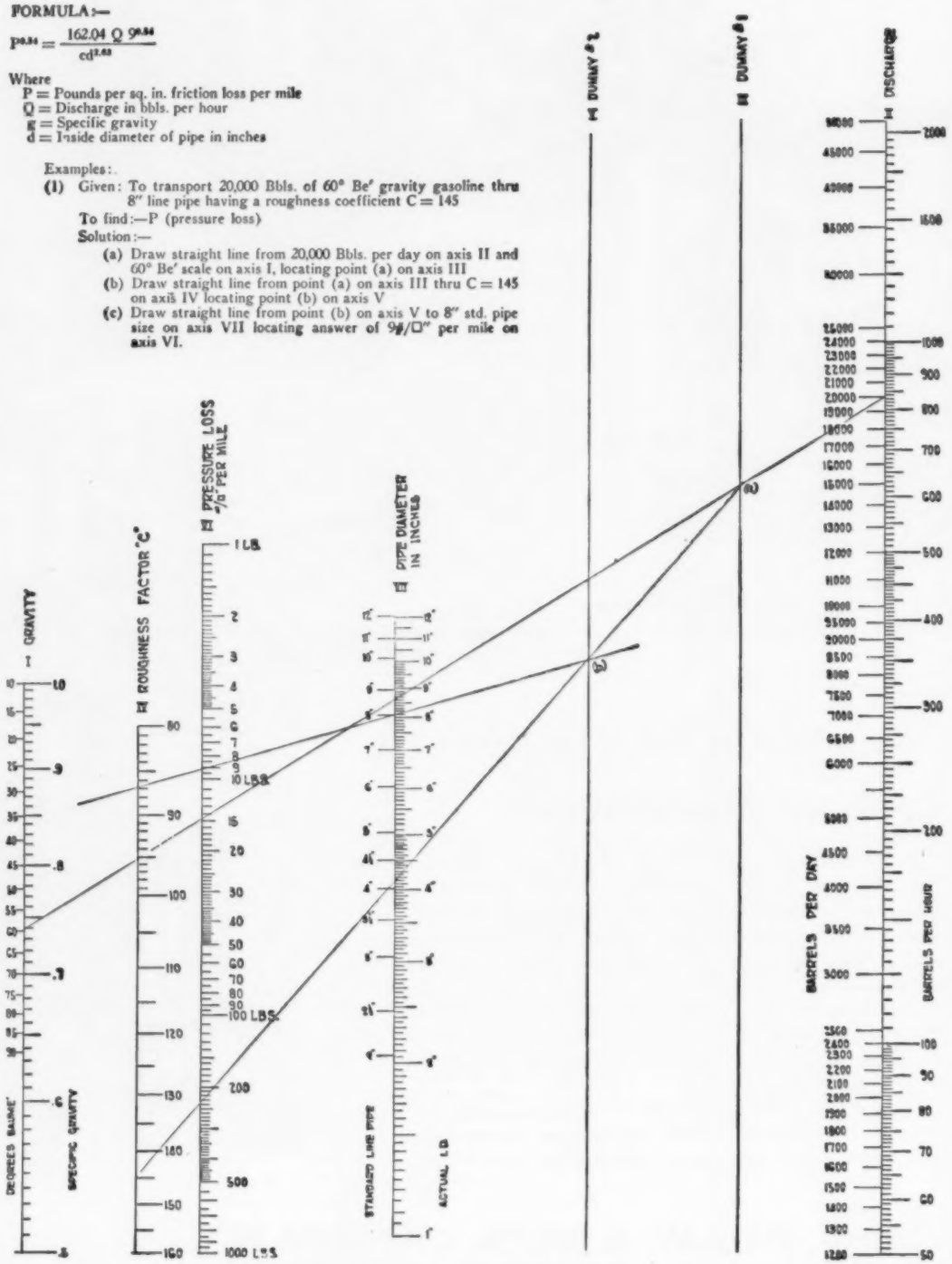
To find:—P (pressure loss)

Solution:—

(a) Draw straight line from 20,000 Bbls. per day on axis II and 60° Be' scale on axis I, locating point (a) on axis III

(b) Draw straight line from point (a) on axis III thru C = 145 on axis IV locating point (b) on axis V

(c) Draw straight line from point (b) on axis V to 8" std. pipe size on axis VII locating answer of 9#/□" per mile on axis VI.

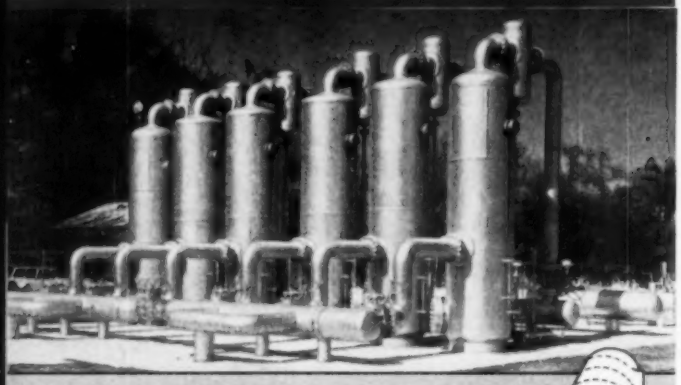


Reproduced by permission of The Natural Gasoline Supply Men's Association

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

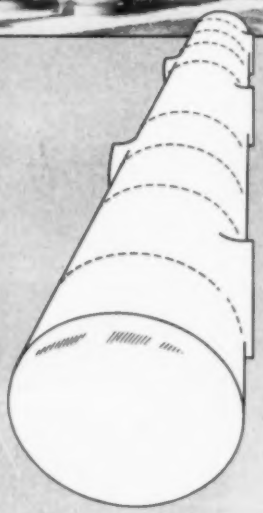
CEMENTING EQUIPMENT
CEMENTING SERVICES
FORMATION FRACTURING
ORBITS of OIL
PRODUCTION STIMULATION
In Halliburton's galaxy of oil well services are its orbits of performance . . . consistent reliability in service to the petroleum industry. Service above all, derived from Halliburton research . . . constantly seeking to make good service better.
D.S.T. EVALUATIONS
ADVANCED RESEARCH
HALLIBURTON OIL WELL CEMENTING COMPANY DUNCAN, OKLAHOMA

How Oklahoma Natural compounded savings by specifying cold extrusion



Oklahoma Natural Gas Company compounded installation savings at their South River Station, Tulsa, by (1) designing for multiple outlet headers and, (2) specifying Fluor-formed headers with cold extruded outlets.

The diagram at the right shows how each of the four 20″ O.D. headers at the South River Station eliminated five 20″ × 20″ × 12″ reducing outlet tees and eight 20″ welds (indicated by broken lines on diagram)—a total saving of 20 tees and 32 welds!



By specifying Fluor-formed headers with cold-extruded nozzle outlets, these added savings were realized

1. IMPROVED STRENGTH & DURABILITY — Polished extrusion dies impart a smooth, dense surface finish to the outlet—assurance of longer service life where vibration or pulsation stresses are involved.

2. CLOSER DIMENSIONAL TOLERANCES — Flowing steel under compression while in a tough stable condition permits extremely close tolerance dimensional configurations—center-to-center and centerline location tolerances are easily held within .060″.

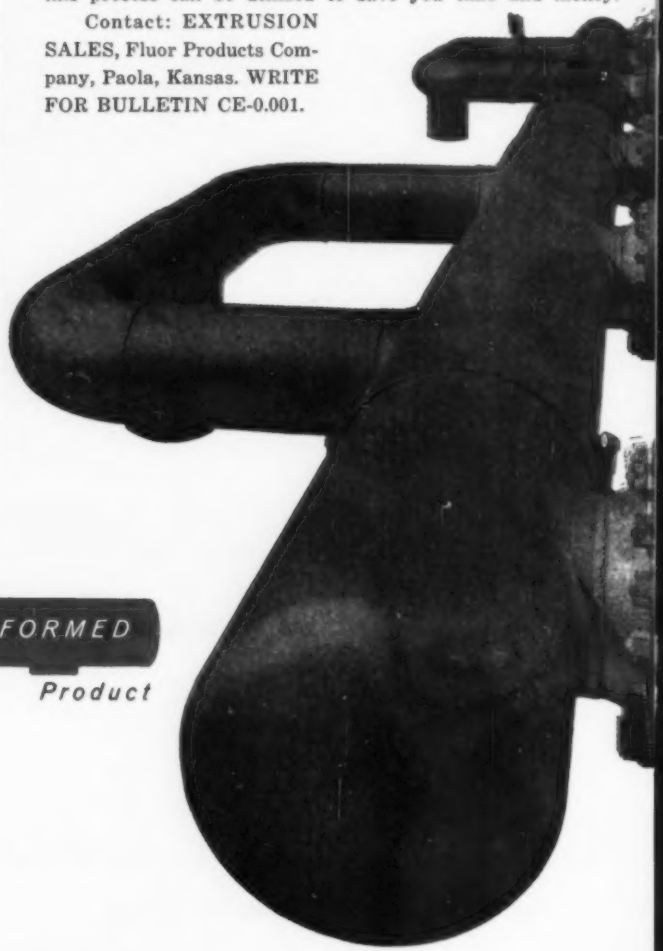
3. LESS MATERIAL NEEDED — Fluor-formed cold extruded multiple outlet headers need no extra length for manufacture—they are made to the exact length and wall thickness required.

4. NO DELAYS — Because nozzle outlets are cold extruded, headers are often made from stock or from the same pipe used elsewhere in a job—production is faster, inspection is simpler.

DIFFICULT JOBS A SPECIALTY

Many difficult design problems can be solved by cold extrusion techniques. Qualified Fluor Products Company engineers are ready to furnish you specialized technical information on how this process can be utilized to save you time and money.

Contact: EXTRUSION SALES, Fluor Products Company, Paola, Kansas. WRITE FOR BULLETIN CE-0.001.



FLUOR PRODUCTS COMPANY

A Division of The Fluor Corporation, Ltd.

General Offices—WHITTIER, CALIFORNIA
Wood Products Mill—SANTA ROSA, CALIFORNIA
Metal Fabrication Shops—PAOLA, KANSAS

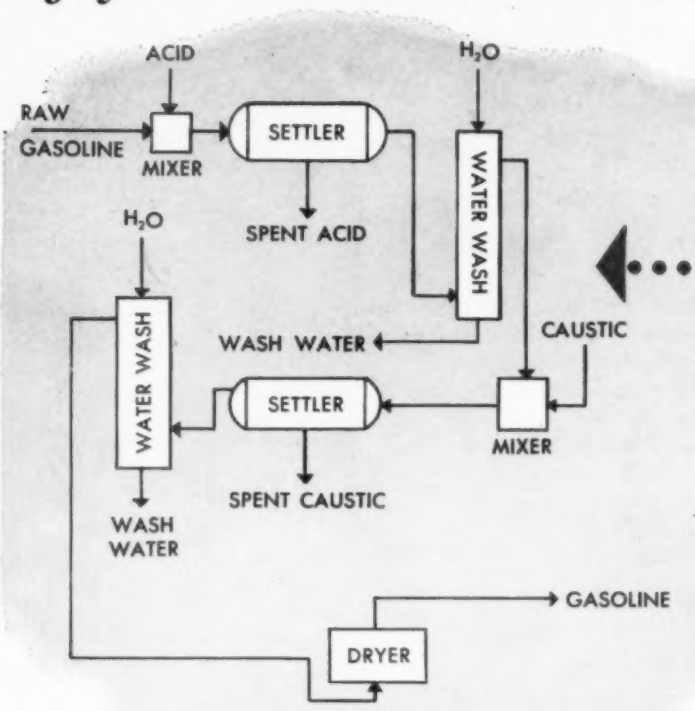
A FLUOR-FORMED Product

MANUFACTURERS AND FABRICATORS OF COOLING TOWERS, PULSATION DAMPENERS, MUFFLERS, PREFABRICATED PIPING AND OTHER WOOD AND METAL PRODUCTS

SALES OFFICES AND REPRESENTATIVES IN: Birmingham, Boston, Buffalo, Chicago, Denver, Detroit, Houston, Kansas City, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh, San Francisco, Tulsa.

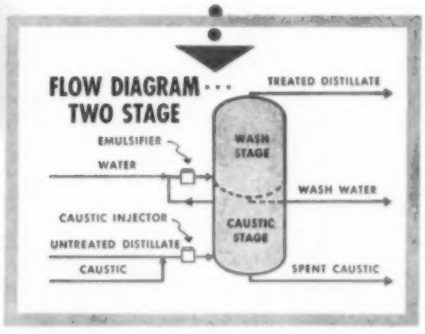
ASSOCIATES: Fluor Corporation of Canada, Ltd., Toronto; Head-Wrightson Processes, Ltd., London, England.

if you acid treat or caustic wash...



YOU CAN REPLACE THIS

WITH THIS



PETRECO ELECTROFINING

saves space, pumps, piping and vessels

Electrofining, as pioneered by Petreco, is a continuous, precision controlled operation that is superior in every way: *easier*, because it affords efficient, once-through treatment; *cheaper*, because it requires but one vessel as compared with the 3 or 4 in conventional systems, as well as proportionately less piping, pumps or ground area; *faster*, because it delivers sharp, clean separation of hydrocarbon and caustic-wash phases, cuts settling time from days to hours. The result is a *finer finished product*, ready for market.

Write for FREE COPY *on* "PETRECO ELECTROFINING—*A New Concept in Light Oil Refining.*"

PETRECO

A DIVISION OF PETROLITE CORPORATION

3202 SO. WAYSIDE DRIVE, HOUSTON 1, TEXAS • 1390 EAST BURNETT STREET, LONG BEACH 7, CALIFORNIA

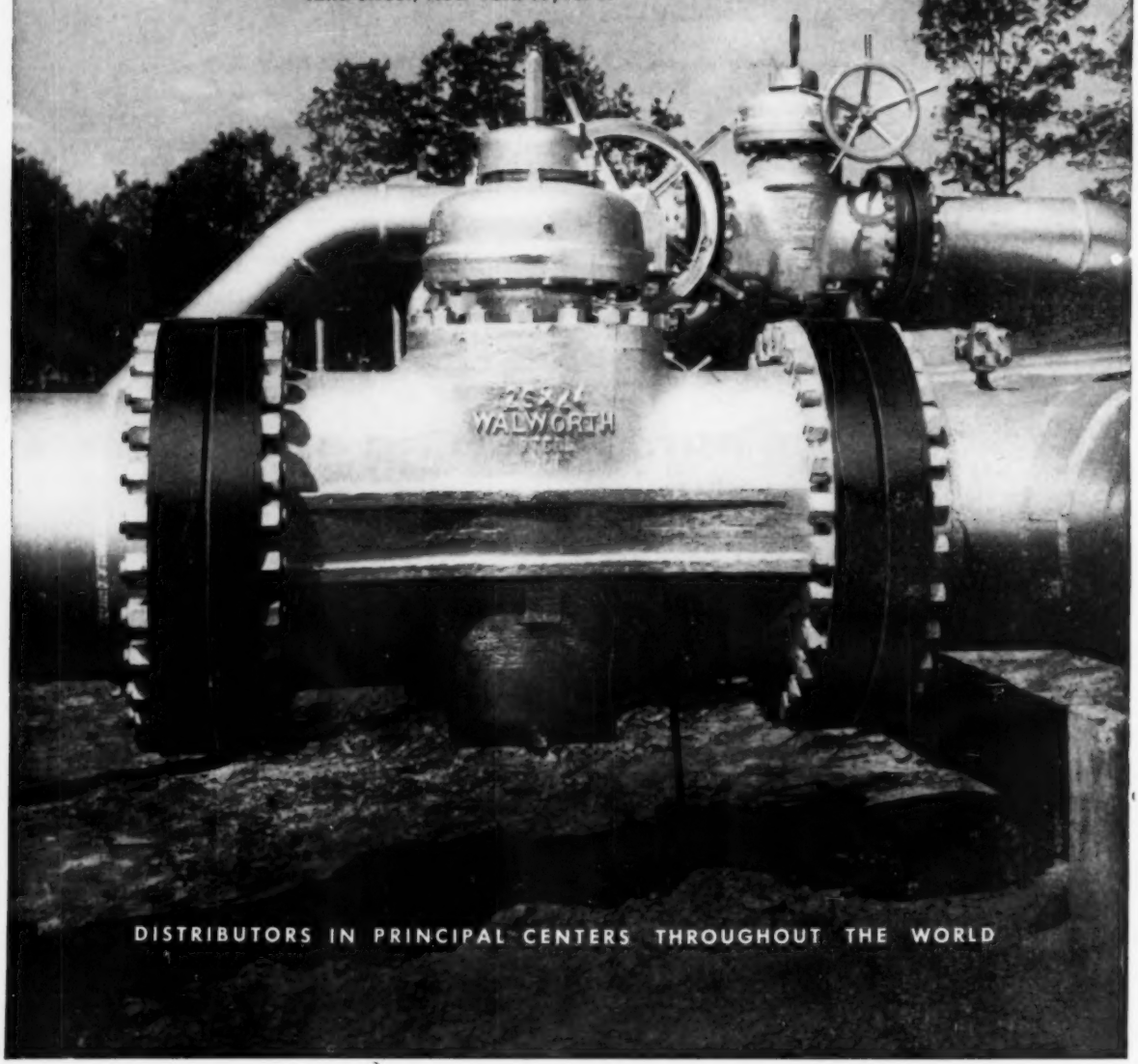
Specialized Electric Petroleum Treating

DESALTING • DEHYDRATING • CAUSTIC WASHING • ACID TREATING • DOCTOR TREATING • SWEETENING • NAPHTHENIC ACID REMOVAL • SEDIMENT REMOVAL

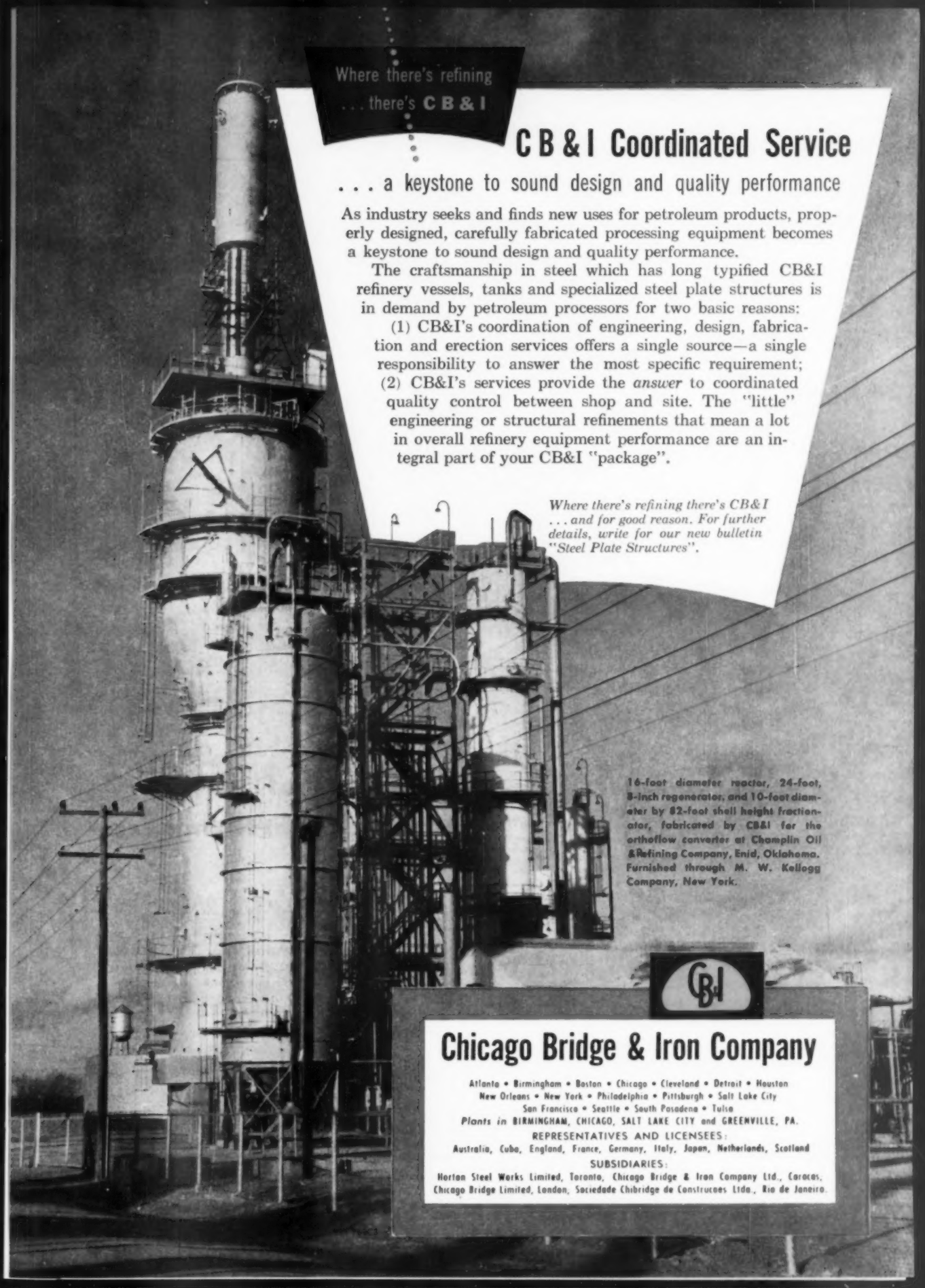
LUBRICATED PLUG VALVES by WALWORTH

Two Walworth Cast Steel Lubricated Plug Valves in use on the main line of a southeastern gas pipeline.

In addition to Lubricated Plug Valves, Walworth manufactures Gate, Globe, Angle, and Check Valves in a wide range of types and sizes for the oil and gas industries. Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.



DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD



Where there's refining
. . . there's **CB&I**

CB&I Coordinated Service

. . . a keystone to sound design and quality performance

As industry seeks and finds new uses for petroleum products, properly designed, carefully fabricated processing equipment becomes a keystone to sound design and quality performance.

The craftsmanship in steel which has long typified CB&I refinery vessels, tanks and specialized steel plate structures is in demand by petroleum processors for two basic reasons:

(1) CB&I's coordination of engineering, design, fabrication and erection services offers a single source—a single responsibility to answer the most specific requirement;

(2) CB&I's services provide the *answer* to coordinated quality control between shop and site. The "little" engineering or structural refinements that mean a lot in overall refinery equipment performance are an integral part of your CB&I "package".

Where there's refining there's CB&I . . . and for good reason. For further details, write for our new bulletin "Steel Plate Structures".

16-foot diameter reactor, 24-foot, 8-inch regenerator, and 10-foot diameter by 82-foot shell height fractionator, fabricated by CB&I for the orthoflow converter at Champlin Oil & Refining Company, Enid, Oklahoma. Furnished through M. W. Kellogg Company, New York.

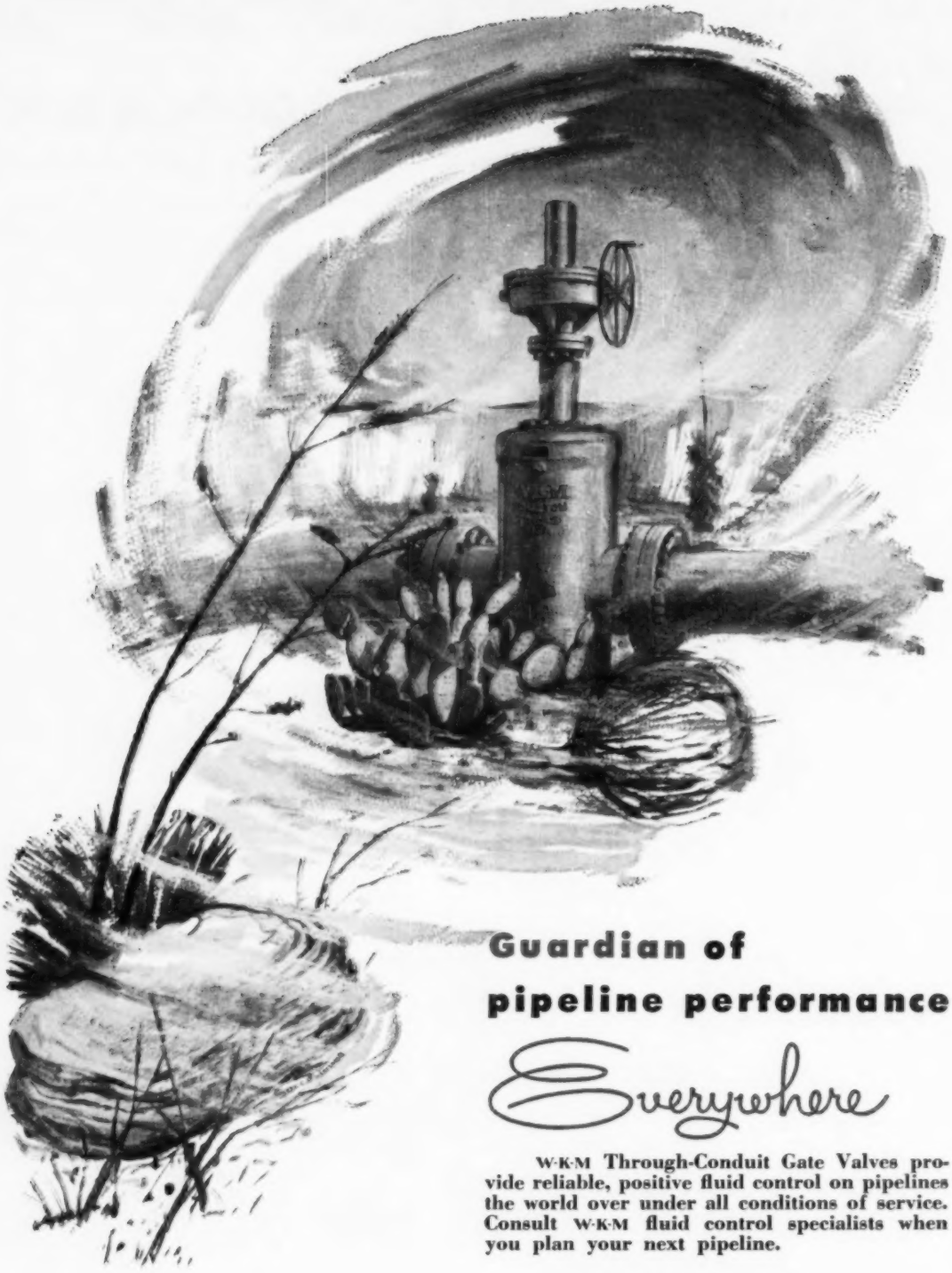
CBI

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

REPRESENTATIVES AND LICENSEES:
Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland

SUBSIDIARIES:
Horton Steel Works Limited, Toronto, Chicago Bridge & Iron Company Ltd., Caracas, Chicago Bridge Limited, London, Sociedade Chibridge de Construcoes Ltda., Rio de Janeiro.



Guardian of pipeline performance

Everywhere

W-K-M Through-Conduit Gate Valves provide reliable, positive fluid control on pipelines the world over under all conditions of service. Consult W-K-M fluid control specialists when you plan your next pipeline.

W-K-M

DIVISION OF acf INDUSTRIES INCORPORATED

HOUSTON, TEXAS

5707

MANUFACTURERS OF W-K-M GATE VALVES acf LUBRICATED PLUG VALVES

KEY-KAST ALLOY STEEL PIPING FITTINGS KEY RETURN BENDS AND FITTINGS

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

First transistor-powered mobile radios up to 60 watts

General Electric's Progress Line mobile radios now offer transistor advantages in all bands.

New transistorized power supply for both transmitters and receivers means no vibrators to replace, no rotating or vibrating parts to wear out. Transistors, plus high quality silicon rectifiers, give you the most dependable mobile communication known today.

Progress Line mobile radios with transistorized power supplies are available in *all* communication bands: 30 or 60 watts in low band (25-54 mc), 25 or 50 watts in high band (144-174 mc), or 15 watts in UHF band (450-470 mc).

OPERATE FROM EITHER BATTERY POLARITY—Only General Electric's Progress Line lets you operate on either positively or negatively grounded 12 volt batteries. This is especially important in fleet operations.

IMPROVED RANGE—Vibrator hash usually associated with receivers is totally eliminated by the use of transistors. The result is maximum receiver sensitivity.

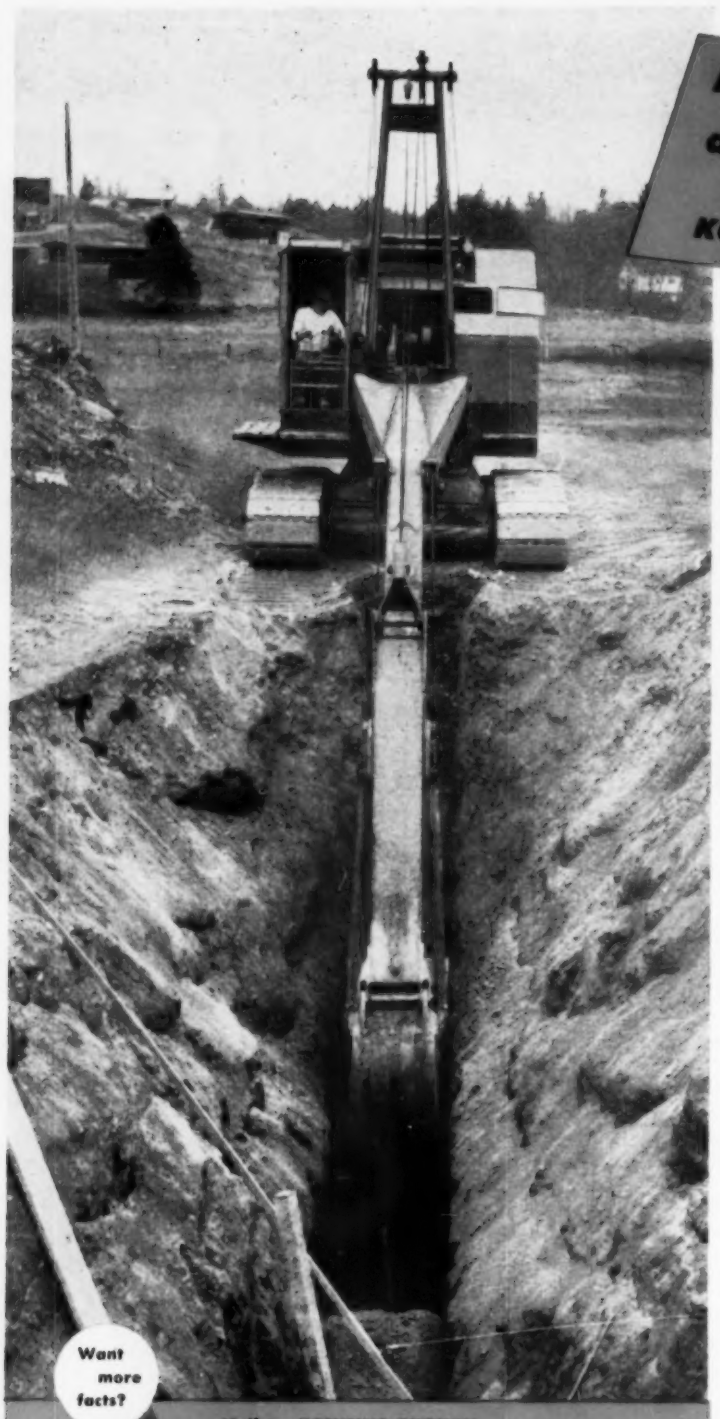
NOT DAMAGED BY VOLTAGE VARIATIONS—Unlike vibrators, transistorized power supplies can withstand battery voltage variations from +20 to −50 percent.

PROGRESS WITHOUT OBSOLESCENCE—No need to buy new power cable or control head. General Electric Progress Line mobile units with either new transistorized power supply or regular vibrator power supply are *completely interchangeable*.

Call your G-E communications consultant for full details. He's listed under "Radio Communication Equipment" in the Yellow Pages. Or write General Electric Company, Communication Products Department, Section 31258, Syracuse, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



Maximum digging depth: 26 FEET with KOEHRING 1-YARD HOE

Combining long, deep reach with heavy-duty digging strength, Koehring 1-yard 405 hoe delivers big-yardage output on pipeline trenches, footings, slush pits and other below-grade excavations. It reaches a long way down, 22½ feet below crawlers with standard boom — *26 feet deep with special boom* — comes up with a full load every pass, in any kind of dirt or rock. There are variable settings on dipper arm — cutting angle is easily changed to best suit digging conditions and type of cut. Big 1-yard dipper makes a wide cut — 43 inches over side-cutters. During the dig-and-swing cycle, close-coupled dipper pulls up tight to boom, avoids spillage as boom is raised. Long reach puts spoil bank well back beyond edge of cut.

Light lever-pull

For all its powerful, fast action, this heavy-duty 405 is an operator's dream! Big power clutch requires only 1/10th the lever-pull of a comparative-size manual clutch — yet retains accurate "feel" of load. Automatic traction brakes also simplify operation — are engaged at all times, except when tractive power is applied. They lock and hold the 405 when working or parked. Maintenance is simplified, too. There are only 2 main shafts in the 405's upper machinery.

Other work capacities:

The 405 readily converts to 1-yard shovel, handles 1 to 1½-yard clamshell or dragline buckets on a wide work radius — has 20-ton lift capacity as a crawler-mounted crane. Your Koehring distributor has more information on this *extra-capacity* 405 that will be of interest to you. Call him — or write.

KOEHRING

DIVISION OF KOEHRING COMPANY

MILWAUKEE WISCONSIN

Want more facts?

Mail to: KOEHRING DIVISION
3026 W. Concordia, Milwaukee 16, Wis.

Send us ☐ Specification Sheet ☐ Price information on 1-yard 405 hoe.

NAME _____ TITLE _____

COMPANY _____ DIV. _____

STREET _____

CITY _____ STATE _____

K838 PE

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Immense valley of the Magdalena is both land and sea. This is the Yarigui-Cantagallo area. Almost in the center is Yarigui No. 4 and hidden in the trees at the left is Cantagallo village.
— *Courtesy Shell Condor, S. A.*

Want to Seek Oil in Colombia?

These are the things to calculate before you search for reserves in South America . . . So far Colombia is behind on reserves . . . The big bonanza may be there but it will take capital to unearth the oil and get it to market

E. Ospina-Racines

A PREREQUISITE for independent operators who seek new oil supplies abroad is to examine some of the economic aspects of such a venture. In some instances new operators in foreign lands have gone abroad without much study, trusting to oil business instinct and unknown risks which they hope will favor them. It is still the same "oil game" moved abroad.

Developing oil supply in a foreign country requires:

1. Obtaining rights to explore for and develop oil.

2. Carrying out oil exploration activities, including surface work, geophysics, if any, and later wildcatting.

3. Testing commercial possibilities of discovered fields.

4. Estimating economics of the venture; that is, gross income and net income, after deducting costs plus taxes.

5. Calculating yield on investment, which because of greater risks and efforts abroad, should be much higher than similar capital risks in the United States.

Our purpose here is to reveal economic data so one can decide whether it is sufficiently interesting to search for

oil abroad and what a new operator may expect. The data presented can only be of past experience and no effort is being made to prognosticate what future situations may hold.

Although the entire continent of South America offers prospective oil land and various conditions to acquire oil rights, this concerns Colombia only. Colombia is one of the best located, with vast areas of prospective oil land. It is one of three net oil exporting countries of the Western Hemisphere, the other two being Venezuela and Trinidad. All other countries are net importers; their indigenous supply is insufficient to take care of their own demand.

Has Private Oil Rights

Unlike other South American countries, in Colombia private oil rights are recognized in addition to government oil rights. Recognition is not exactly as in the U.S. where the owner of the surface is owner of the subsoil oil rights. In Colombia the government has established that all oil rights belong to the state, unless the surface owners show otherwise. The oil law lists what evidence is required to obtain recognition that the oil is privately owned. In Colombia, therefore, you may lease a private oil land or seek a national concession from the government. Sometimes you may hold both in the same tract. The Texas Velasquez field is within a 315,000-acre tract, owned in fee; likewise the production from its Ortega field is from a private lease; Intercol's Gualanday production is from a private lease, although situated within a national concession.

The oil law prescribes the terms for acquiring a national concession. The interested party files maps, geological and topographic: an opinion on the oil-bearing possibilities of the tract; an astronomical point to tie the boundaries if natural boundaries are not definite, and banking references. If the ministry holds that documents fulfill the legal requirements it announces that the application has been "accepted." When the announcement is made public any alleged private-oil landholder may file a claim that his farm or property is private with respect to the oil which may be found. The matter is then referred to the courts. Meanwhile the block may be contracted and the procedure to obtain recognition continues. The operator usually leases such alleged claims, contingent on the court decision. Procedure to obtain recognition of private oil claims is drawn out, delayed, expensive and most of the time beyond the means of the surface owners.

Cost of acquiring concessions and terms for leasing oil lands are numerous. An operator can either file for his own account or obtain transfer of applications filed by others through direct deals. Blocks may be solicited as government concessions from 12,250 acres (5000 hectares) to 500,000 acres (200,000 hectares). Unlike what has taken place in Venezuela recently by the granting of some 2,000,000 acres of new concessions by bidding for the areas, in Colombia, the first applicant has priority—similar to making a mining claim.

In Venezuela bids for new acreage have been acquired by paying from $19.64 per acre to as high as $2832 per acre, the former in less attractive and inland areas and the latter in a national reserve in the Lake Maracaibo. In Colombia there is no bonus payment at present and the operator pays for the cost of the documents as indicated above to file. If, as is the case now, most of the prospective oil land has been solicited in concession, a deal has to be made with other oil firms who have filed and are willing to farm out some of the blocks.

Typical "Deals"

Farmout deals made recently exchange a 50 percent interest in a block or area of several blocks in return for drilling one or more wells or a minimum footage of some 18,000 ft equivalent to two medium deep tests. Cost of acquiring the acreage is the cost of drilling one or two wildcats to around 10,000 ft. In Colombia on the coast such outlay may come to around $100 per ft which includes geological, geophysical, and wildcat drilling operations. The latter imply road and camp construction to the site, which means outlays from $100,000 to several times this amount.

In other deals 100 percent of the block may be acquired through transfer of a concession application of independent promoters. In general a 50,000-hectare block (122,500 acres) on the coast may be obtained by paying from $1 to $5 per hectare transfer; an overriding royalty from 1 to 6 percent depending on the government royalty, which runs from 3 percent for inland properties, more than 540 miles to 13 percent for concessions within 62 miles of tidewater; a severance tax on private oil runs from ½ percent for properties beyond 540 miles inland and increasing gradually to 7 percent for properties up to 62 miles from tidewater.

Some contracts carry these stipulations and a clause calling for a bonus of some $5 per hectare if the concession is placed in commercial operation, which for a 50,000-hectare block means the payment of $250,000 when oil has been found and sales are taking place.

In the farmout blocks, once oil has been found the original holder can exercise the option to put up 50 percent of the development outlay for his half of the future oil production. This is not the case where the operator holds the block entirely. An operator, therefore, must earmark at least one-half million dollars, minimum, to venture an operation in Colombia, acquire oil rights, and drill one test well.

Capital Outlays

In Table 1 a listing appears of the dollar value of oil investments—loans costs of exploration and operations. Note capital outlay of Cities Service during the first two years of $1.5 million and during the first 5 years, $7.5 million.

Item No. 9 refers to the overall Texas investment—the first wildcat for Texas was spudded December 1945—which proved to be a discovery in the Velasquez field. In October 1955—10 years later and some 95 wells drilled, the field was placed in commercial pro-

The Author

E. Ospina-Racines is editor and publisher of various oil industry information services, covering not only Colombia but all South American oil developments. He acts also as an oil lease broker and has been successful in closing a number of deals. The most recent one with Colombian Sun Oil Company covers an 88,000-acre concession in the Sinu area, Caribbean Coast. Born in Bogota, he was educated and lived 21 years in the United States. He received a BS in engineering and later studied geology at La Sorbonne in Paris and law in Bogota. In 1951 he published a worldwide best seller in its field, "The Economics of United States and World Oil." He was the Colombian government delegate to the World Petroleum Congress and is now president of the Colombian Petroleum Institute.

TABLE 1. Dollar Value of Investments-Loans-Costs of Exploration & Operations in Colombia 1920-1957.

Company or group & time period	Year time	Nature of investment	Amount of U. S. $
1. Tropical Oil Co. & /or International Petroleum Co. (SONJ affiliates)	1957	Exploration budget	$ 13,414,000
	1956	Exploration budget	12,133,000
Intercol—1953-1954	1955	Cost of oil exploration	34,000,000
Intercol—1951-1952		Cost of oil exploration	11,000,000
Tropical—prior to Dec. 31	1951	Cost of oil exploration	32,000,000
Total—both prior to Dec. 31	1955	Cost of oil exploration	$ 76,568,000
2. Loans & investments Intercol		Cartagena refinery-building 28,500 B/D	$ 32,500,000
3. Esso (marketing)—Colgas LPG marketing-products pipelines		Service stations-products pipelines—LPG distribution	$ 24,311,400
4. Loans to Ecopetrol and to Cundinamarca dept.		To build products pipelines and Barranca refinery	$ 15,400,000
5. Richmond Petroleum Co. (S. Cal.) 1920-1955		Cost of oil exploration 35 wells drilled	$ 35,000,000
6. Socony and Mobil Oil de Colombia 1934-1945		Cost of oil exploration	$ 17,520,000
1946-1955		Exploration—estimated	$ 5,000,000
7. Colombian Petroleum Co. & Sagoc (Mobil-Texas since 1936)	1916-1933	Oil exploration	$ 21,387,000
	1933-1939	Field Development	19,637,886
	1937-1939	Sagoc pipeline 261 mi.	19,285,114
	Total outlay to 1939		$ 60,310,000
8. Shell Group	1934-1945	Exploration and field development	$ 35,000,000
	During 1945	Investments & operations	$ 27,124,400
	1951-1955	Average during 5 years	$ 25,400,000
	1955	Marketing investment	$ 2,050,000
9. Texas Petroleum Co.	To Dec. 1955	Exploration & development	$ 95,000,000
		In fee property—pipeline included above	$ 45,000,000
10. Cities Service & Ecopetrol		During first 5 years	
Contract obligations		Minimum exploration outlay	$ 7,500,000
for oil exploration		Maximum exploration outlay	$ 10,500,000
75%—Cities Service		During first 2 years	
25%—Ecopetrol		Minimum outlay	$ 1,500,000
		Maximum outlay	$ 6,000,000
11. Colombian Development Co. & Texon Drilling Co.		Floresanto exploration—rig drilling—consession, etc.	$ 105,000
		1 year operations	$ 421,933

Source: Intercol & Tropical — Memorandum of June 20, 1956, No. 1 to 4
Richmond " Intermedio — Bogota press No. 5
Socony " El Tiempo — Bogota No. 6
Colombian L. M. Fanning "Foreign Oil & The Free World" No. 7
Shell Boletin de Prensa of Shell, March 1956, No. 8
Texas Revista del Petroleo No. 21 of August 1952
Memorandum of the Company No.-9
C. Service & Ecopetrol: Contract — Revista del Petroleo No. 61 January 1956, No. 10
Col. & Texon Report on Floresanto Concession — No. 11

duction with a pipeline outlet to tidewater—some 440 miles to the Caribbean Coast—about 310 miles via the common carrier and 110 miles through its own pipeline connecting with the Andian. The Velasquez field was placed in commercial production after investing some $45 million—including about $6 million for the 110-mile 10-in. pipeline.

Shell Largest Producer

Shell, Item 8, had invested in its overall exploration and development activities $35 million, at which time it started to pump some 8000 bbl a day of oil along the 300 miles via Andian to Caribbean tidewater. During the 20 years 1937-1957 Shell has invested $310 million and the value of its exports has amounted to $270 million — still 15 percent less in balancing investment with exports. Shell is now Colombia's foremost producer with some 41,000 bbl a day or one-third of the total oil output of the country. In 1956 Shell exported 50 percent of the crude of Colombia or 14.6 million bbl worth $31.3 million or 44 percent of total value of oil exports.

Exploratory Costs

For a year's exploratory program, note the Intercol budget for 1957 of $13.4 million and the 1956 budget of $12.1 million. In this short article details cannot be given of the oil exploration expenditures. For geophysical exploration the outlay currently in Colombia is around $42,000 per month per crew, about 30 percent cheaper than in Venezuela. Wildcat drilling may be estimated from $50 to $100 per ft, the range depending on many factors.

After making such exploratory and development investments, what are the possible rewards? How much oil will be found and what will be the size of the oil fields? For the country as a whole, a total of 1.5 billion bbl has been found of which 764 million bbl had been produced to December 31, 1956. These data cover the period 1920 to 1956 or 36 years of oil activities in Colombia. This seems rewarding compared to the total capital outlay either invested or earmarked, totaling $540 million. The average sale price of Colombian crude f.o.b. during this time has been about $2.40 per bbl, which, applied to the 764 million bbl produced, gives a gross income of $1.8 billion. However, for the particular operator this relation may not be so rewarding.

In general an operator must seek the discovery and development of fields that total at least 100 million bbl of commercial oil, which must be produced within the 30 years of concession contract. In Colombia the concessions and all property therein revert to the government at the end of the concession period. The operator cannot

Downtown in Bogota, where most of the oil companies have their Colombian headquarters. A cable car goes up the mountain at right to the famous Monserrate sanctuary (10,340 ft altitude) which lighted at night looks like a shrine in the sky. — *Courtesy Braniff Airways*

count on any salvage value of his property, unless he is exploiting a private field, as in the case of Texas at Velasquez.

For oil developments in Colombia's Llanos area, more than 540 miles from the Caribbean Coast, an operator must seek at least one billion barrels of commercial oil. A pipeline to seaboard is estimated at some $125 million. Because of their magnitude, these operations are necessarily joint ventures similar to Middle East oil projects.

After a wildcat has discovered a pool in the Llanos of Colombia, it is doubtful if such oil can be delivered for export within less than 10 years. The capital investment to place such oil at tidewater must include a pipeline to seaboard. Unlike oil discovered in the United States, all future oil discovered in Colombia is for export. The country's oil products consumption amounts currently to some 45,000 bbl a day, which leaves a balance of some 80,000 bbl a day for export.

High Output Per Well

A clue as to the situation for the particular operator may be obtained from the size of the oil fields now producing as appears in Table 2. Texas for instance, is producing 28,350 bbl a day as of July and obtained this output from five fields ranging from 96 to 21,320 bbl a day. Shell with 33.3 percent of Colombia's oil output obtained its 42,805 bbl a day from four fields ranging from 2629 to 30,242 bbl a day. Producing characteristics of Colombia's oil fields to date place these fields in the medium category. Much larger fields are producing in Venezuela.

In the latter country 2.6 million bbl a day are produced from 100 fields and in Colombia 125,194 bbl a day are obtained from 22 fields. Published data reveal the following comparison for 1956 oil output for these countries: Middle East 5000 bbl a day per well; Venezuela 175 bbl a day per well, Colombia 63 bbl a day per well, United States 13 bbl a day per well, Canada 43 bbl a day per well.

Of course individually some wells in Colombia are producing as much as 4000 bbl a day per well. Compared to other Western Hemisphere countries, Colombia is due to reward the active oil operator by the size of its fields and the yield therefrom.

Tax set-up and fiscal aspects of oil production are decisive factors in establishing the net income and yield on the investment in lands abroad. In Colombia the government has established the 50-50 net profits split for the oil industry. Data compiled by the author for the period 1952 to 1955 show that the oil industry operates closely to the profit split. Net income thus obtained by the operator, however, does not necessarily mean that it is a reasonable or even attractive return on the invest-

TABLE 2. Typical Weekly Summary of Current Oil Drilling & Production in Colombia.

Operator:	Ecopetrol	Texas	Colpet	Shell	Intercol	Richmond	An-Son	Mobil	Colciteo	Colombia
Rigs: Wildcat	0	2	1	1	3	1	0	1	1	=10 wildcat rigs
Field	2	5	8	2	0	0	1	0	0	=18 field rigs
Service	4	4	5	4						=17 service rigs
Weekly footage	1123	10,133	7889	7372	800	1005	0	0	1030	=29,352 ft

TABLE 3. Production in Colombia 1957.
Barrels Per Day, Crude, Condensate and LPG by Operators.

Month	ECOPETROL Crude	ECOPETROL Cond	COLPET Barco	COLPET Cicuco	SHELL Yondo	SHELL C-gallo	SHELL S. Pablo	SHELL Dificil	TEXAS Velasquez	TEXAS Palagua	TEXAS Tetuan	TEXAS Ermitano	Intercol Ag.+Tot +Gualand.	TOTAL B/D
J.....	29,296	2344	26,109	110	30.745	2665	4473	1364	24.405	3292	964		423	= 126,195
F.....	29,135	2135	26,617	258	30,840	2634	4258	1293	22,296	4230	1251		414	= 125,991
M.....	29,046	2095	26,447	301	31,419	2590	3937	1297	22,655	4758	1249		395	= 126,189
A.....	28,990	2064	26,006	488	31,550	2570	4430	1339	21,976	4851	1239		375	= 125,878
M.....	28,899	2229	25,953	612	31,292	2608	5796	1307	22,664	4730	1242		351	= 127,583
J.....	28,743	2252	25,081	699	30,701	2563	8374	1275	22,126	5267	1277		317	= 129,575
J.....	28,734	2257	25,311	631	30,242	2629	8635	1299	21,320	5579	1257	194	233	= 128,321
A.....	27,885	2175	25,573	733	30,093	2594	8268	1256	21.430	5583	1016	211	236	= 127,053
S.....	27,877	2274	25,429	1039	29,754	2374	7820	1222	21,194	5601	1163	285	230	= 126,260
O.....	28,242	2179	24.593	2381	29,727	2485	7180	1211	21.363	6381	1236	481	402	= 127,861
N.....	26.664	2075	23,650	4380	29,518	2407	6926	1188	22,353	6768	1076	519	310	= 128,680

GAS-OIL

A PARTNER IN PROGRESS

Oil men serve the nation by unlocking natural fuels from the rocky vaults of the earth. In the vast oil and gas producing fields, these men scientifically drill, transport, process and distribute black gold and blue flame for the fuel needs of our dynamic economy. YOUNGSTOWN steel men join their oil and gas partners in contributing toward progress and an even greater standard of living!

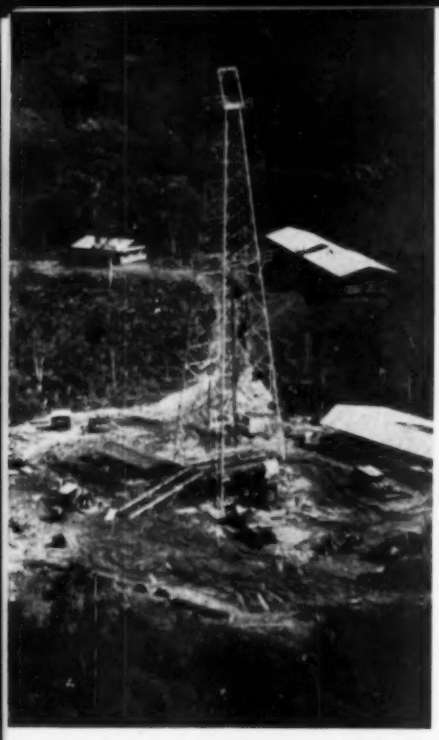
QUALITY YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Producers of Carbon, Alloy and Yoloy Steels

Youngstown 1, Ohio

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



The rig towers over the surrounding tropical rain forest in this clearing hacked from the jungle. Buildings are well-site facilities for laboratory work, housing and dining. This is the wildcat drilled by Socony Mobil on the Chagui River in southern Colombia, on the West Coast.

ment. Data of the Chase Manhattan Bank reveal that the oil industry of the United States as a whole obtains a net return of around 13 percent on its investment. This means that an operator seeking oil abroad does so to obtain a greater than 13 percent yield on his operations.

Depletion Deduction

The government has instituted a depletion deduction aimed at favoring the active operator and has taken into account the greater risks and economic difficulties of future Llanos oil providing for a 40-60 net profits split, the latter in favor of the operator. A summary of the depletion incentives for Colombian oil appears in Table 4, a summary of Decree 2140.

Currently the average f.o.b. price for crude exported from Colombia is $2.42 per bbl. Government royalties, surface fees, income taxes and miscellaneous levies take 69 cents per bbl. This means that on a 50-50 basis the industry can expect net income per barrel of around $1.04 for Colombia oil under current circumstances. If an operator seeks more than a 13 percent yield on his oil industry investment, which is what he would obtain in general in the United States, his investment per barrel will have to be less than $9 per bbl of oil produced. If he seeks about a 26 percent yield which is the highest recorded for oil capital in Venezuela, his investment should not be higher than $4.50 per bbl of oil produced.

As of December 31, 1956, capital of the oil industry in Colombia amounted to $257 million, which divided by 28 million bbl produced per year (excluding official oil production which does not pay royalties nor taxes) gives a unit investment index of $9.20 per bbl. This would indicate a nominal return for the oil industry of Colombia of 7.5 percent annually on the oil capital invested in the country. This may be compared with the high of 26 percent for Venezuela and an average of around 20 percent in general. The only way to improve Colombia's return is by the discovery of new and prolific oil fields near tidewater.

These are a few of the economic considerations an operator must study before venturing abroad if he is not to trust exclusively to luck. ★ ★ ★

TABLE 4. Summary of Provisions of Decree 2140 Establishing Tax Incentives for the Oil Industry of Colombia. (August 3, 1955)

For Oil Properties in Western Colombia (Caribbean — Pacific — Magdalena Valley)

Property and status of operator	Depletion deductions-%	Maximum deductions-%	Terms and conditions granted.
1. Current producing properties—no further oil exploration.	10%	35% of net income	Deplection deduction allowed up to amount invested in intangibles—on 1955 returns and thereafter. No 35% limit when "unit cost" is basis.
2. Current producing operators which invest no less than Ps 2 million annually ($800,000) in oil exploration Art. 5.	10% + 15% total 25%	35% of net	Deduction allowed irrespective of total intangible investment in producing properties.
3. Current producers and future producers—with new oil properties Art. 5 p. 2.	25%	50% of net	Deduction allowed irrespective of total tangible investments, maximum raised to 50% of net.
4. For unsuccessful properties subsequently abandoned Art. 6.			May amortize oil exploration from current incomes up to 10% ann.
5. Producing operators with no further oil exploration in the country—outside of producing propreties. Art. 7.			May amortize intangible investment with 10% depletion deduction plus up to 5% additional.
6. Renewal of oil exploratory activities. Art. 8.			The 15% additional deduction re-granted, plus 10% basic depletion
7. When operator loses the 15% additional if he foregoes oil exploratory activities. Art. 9.			May amortize investments either thru a)annual 15 % deduction up to even Ps 2 million amount or b) thru 5% and 10% as provided in Art. 7.
8. For properties that start commercial oil after this Decree. (Art. 10)			Total income taxes plus royalties may not exceed 50% nor be less than 40% of net taxable income.

Provisions Applicable to Eastern Colombia (Llanos)

1. Commercial exploitation period increased from 40 to 50 years and renewal from 10 to 20 years—total 70 year commercial period (Art. 11).
2. Surface fees are suspended while a drilling rig is maintained active (Art. 12).
3. Depletion deduction for Llanos will be 28% of (Gross income-3%) = 27.16% of gross income priced at port; to amortize intangible investment made elsewhere in the country also. Deduction is not to exceed 50% of net income (Art. 13). May exceed 50% if basis of deduction is "unit cost."
4. Unsuccessful investments in Eastern Colombia may be deducted as losses from gross income when property is surrendered and abandoned; or they may be capitalized and amortized through the depletion deduction.
5. Total income taxes plus royalties may not exceed 40% of net taxable income.
6. A 3% royalty is fixed for Llanos oil, appraised at port, even if field is located at less than 900 k. (558 miles) from port.
7. The pipeline transportation tax (Volume x tariff) of 4% is reduced to 2%.
8. Provisions of this Decree for the Llanos, are applicable if operator contracts and/or wildcats within 10 years hereafter.

Management Personals

Fred W. Bartlett, a former Southwesterner prominent in oil development along the Gulf Coast and in South Texas, became chairman of the board of Socony Mobil Oil Company, Inc. He succeeds **B. Brewster Jennings,** who announced his retirement in January as board chairman and chief executive officer of the company. **Albert L. Nickerson,** president of Socony Mobil since July 1955, became chief executive officer.

Bartlett graduated from the University of Michigan in 1921. He was employed as a geologist by a major company in the San Antonio-Corpus Christi areas for several years before joining Socony Mobil in 1939.

T. M. Hipp was named manager of a newly formed mining and milling department of Phillips Petroleum Company. His offices are at the company's Bartlesville, Oklahoma, headquarters, where **Bradley Skinner** is technical assistant to the manager. **A. A. Ruoho** was made general superintendent and **R. W. Jenkins,** mines superintendent.

Hugh L. Hemmingway was appointed director of research for the Pure Oil Company. He will direct the activities of the company's research center at Crystal Lake, Illinois, which becomes his headquarters. **C. M. Ridgway** will continue as manager of the center. Hemmingway, formerly general manager of the marketing division's sales-service departments, has been closely associated with Pure's research activities since joining the company in 1944. A mechanical engineer, he is a former president of the National Lubricating Grease Institute.

Robert J. Askevold and **Dr. Donald C. Bond** were named to newly created positions as assistant research directors of Pure Oil, and **Dr. Milton M. Marisic** to assistant manager of the research center at Crystal Lake. Askevold will be in charge of marketing and refining activities, and Dr. Bond in charge of production and transportation research.

T. C. Twyman was elected senior vice president in charge of coordinating The Texas Company's world-wide sales interests and activities. He is president of McColl-Frontenac Oil Company Limited, an affiliated company of Texaco, with headquarters in Montreal. It was announced simultaneously by McColl-Frontenac that **A. Neil Lilley,** who has resigned as vice president and director of The Texas Company, was elected to succeed Twyman as president of McColl-Frontenac. **Harvey Cash,** assistant to the board chairman of Texaco, has been elected vice president in charge of foreign operations-Eastern Hemisphere, succeeding Lilley.

O. B. Schier, II was appointed secretary of The American Society of Mechanical Engineers announced **James N. Landis,** 1958 president. Schier, who was designated secretary-elect last June, succeeds **Clarence E. Davies** who was secretary of ASME for 23 years.

A graduate of Lehigh University, Schier holds mechanical engineering and master's degrees from that institution.

Ben S. Smith, El Dorado, Arkansas, director of industrial relations for Monsanto Chemical Company's Lion Oil Company Division there, has been appointed manager of personnel research for the company's personnel relations department at St. Louis. **Don H. Salyers,** El Dorado, has been promoted to director of personnel relations for Lion Oil there, after serving as supervisor of wage and salary administration in the industrial relations department of that division. **George D. Chappell,** Corsicana, Texas, has joined the research department of Lion Oil at El Dorado, after serving as a technical trainee with Anderson Clayton & Company at Corsicana. **Courtland M. Henderson,** Ferguson, Missouri, has joined the research department of Monsanto's research and engineering division at St. Louis, after serving as technical superintendent of research and development for Mallinckrodt Chemical Works, St. Louis.

William F. Robinson, a chemical engineer who has been with Esso Standard Oil Company since 1946, will manage a new economic and technical division of New York headquarters.

Dr. Herbert J. Stack, recently retired director of New York University's Center for Safety Education, has become associated with the Esso Standard Oil Company as consultant to the Esso Safety Foundation.

Robert H. Chitwood of Bartlesville, Oklahoma, was named assistant to Gerald McGrew, manager of Cities Service Oil Company's crude oil supply division. Chitwood succeeds **Robert V. Sellers,** who is being transferred to New York as staff assistant to the manager of supply and transportation of Cities Service Petroleum, Inc.

Chitwood joined Cities Service in 1952 as a member of the company's college graduate training group and in 1954 became co-ordinator of crude oil movements for the Bartlesville company's crude oil supply division. Sellers has been with Cities Service since 1951, serving all but one year in the company's crude oil supply division. He was on the staff of the Petroleum Administration for Defense at Washington for a one-year period.

Paul Ravesies, petroleum engineer, **D. E. Hibbard** and **T. A. Edwards,** geologists, and **H. T. Christensen,** accountant, all of Seaboard Oil Company, were transferred from Dallas to Caracas, Venezuela.

Ravesies is in charge of the new office in the Edificio Union, Sabana Grande, Avenida Abraham Lincoln.

John D. Wells has been appointed a senior staff engineer in the engineering coordination unit of Esso Research and Engineering Company. Esso Research is the central scientific affiliate of Standard Oil Company (New Jersey). In his new assignment he is responsible for the staff engineering work for affiliates in Cologne and Hamburg, Germany, and Rotterdam in The Netherlands. **Orville L. White** was also appointed a senior staff engineer. He is handling the staff engineering work in connection with Esso Standard's refinery in Baton Rouge, Louisiana, and refineries of Carter Oil Company, Humble Oil & Refining Company and Imperial Oil Limited in Canada.

Dr. Bryon M. Vanderbilt has been appointed senior research associate. He had been an assistant director in the firm's chemicals research division. In his new post, he will be concerned chiefly with work in the reinforced plastics field. **Walter H. Rupp** was named a senior staff engineer in the engineering coordination unit of Esso Research and is responsible for the staff engineering activities for affiliates in Aruba, Cuba and South America.

Howard R. Tate has been named a consultant for the Fifth World Petroleum Congress to be held June 1958. He retired from Esso Research and Engineering Company after 38 years' service.

Lynn (Sandy) Adams has joined Kerr-McGee as a vice president and general counsel. He will handle and coordinate all legal work for the company. Adams received his law degree in 1926 from the University of Missouri law school and began practice in the Holdenville-Wewoka area of Oklahoma. He has been in private practice in Oklahoma City since 1930.

William H. Clingman Jr. has been promoted to the position of group leader, petroleum section in the research and development department of American Oil Company. He joined the research and development department of American Oil as a chemist in October 1954. Dr. Clingman has published a number of articles in the field of petroleum and chemicals research and holds various patents.

F. C. Ryland was appointed executive director of the Iraq Petroleum Company and its associated companies. **G. W. Dunkley** is the retiring executive director. Ryland was formerly in the London offices as general manager in charge of services and planning. He was a scholar of Clare College, Cambridge.

R. I. Brougham, Arabian American Oil Company's vice president in charge of finance moved his headquarters from New York City to Dhahran, Saudi Arabia and, in addition to his present duties, he assumes charge of concession affairs later this year.

L. M. Snyder, vice chairman of the board of Aramco Overseas Company, was elected chairman and chief executive officer of the company. Snyder is also a vice president of the Arabian American. He will continue to make his headquraters in Dhahran. AOC, which has headquarters in The Hague, Netherlands, is a wholly owned subsidiary of Aramco.

William L. Boyer was elected president and a director of Bandini Petroleum Company replacing **John P. Hurndall,** who resigned. Hurndall will continue as a consultant to Bandini and will devote most of his time to the operation of the company's foreign oil concessions in British Honduras and Guatemala. Boyer has been executive vice president of Bandini and formerly was general manager of the Richard S. Rheem oil interests. In addition to Boyer, other directors of Bandini are **Major General (Ret.) Frederick L. Anderson, Edward H. Heller, Donald Royce** and **R. H. Tecklenborg.**

DEATHS

C. "Slim" Harrison, 89, died of a heart attack January 13 in Houston, Texas. He suffered a fall at his home December 21.

Leland K. Spink, 58, engineer in charge of flow measurement at The Foxboro Company, died December 23 in Foxboro, Massachusetts.

Charles E. Whittaker, 50, president and general manager of Globe Oil Tools Company, Los Nietos, California, died December 21, after a long illness.

Hugh L. (Pert) Sargent, vice president, oil tool sales, Sargent Engineering Corporation, died after a brief illness, November 21 in Pittsburgh.

John H. Vohr, 64, general superintendent of United States Steel Corporation's Gary Steel Works, died December 1 following a brief illness.

LAUGH with BARNEY

Then there was the citizen who went to the sugar-ration board and attested: "My wife has no sugar at all in our house — not an ounce of it!"

"Remember now, you're swearing to this," the secretary of the board warned him. "You've got to tell the truth."

The citizen hesitated, and repeated, "Gotta tell the truth?"

"Yes, or you will go to jail," he was warned.

"In that case, I'll tell you the truth. We ain't even married."

Society Note: The most lavishly dressed woman at the reception was Alice S. Smith, who wore a lovely black velvet dress cut so low in the back that you could see her initials.

Two buxom hens were pecking away in the barnyard. Suddenly one of them looked over her shoulder and said to Sister Kate, "We'd better separate. Here comes that cross-eyed rooster, and we don't want him to miss *both* of us."

Ad in newspaper: For Sale — a nearly new typewriter by a stenographer with a wide carriage.

Lulu thought Peter Pan was a hospital utensil.

Exactly nine months to the day after a certain young couple had been married, the wife was rushed to the hospital for the blessed event.

Not long after her arrival, the doctor came from the delivery room and approached the husband with, "Congratulations, young man, you are the father of an eight-pound boy!"

The new father pulled his watch from his pocket, consulted it, and said, "Well, well, exactly nine o'clock. Ain't nature grand."

A few minutes later the doctor came out again, approached him and beamed, "Now, again, my congratulations, you're the proud father of a baby girl!"

Once more the new father pulled out his watch, consulted it, "Well, well, exactly nine-thirty. Ain't nature grand." Then he started off down the hall.

"Hey, wait a minute," said the doc as he halted him, "where are you going?"

"Oh, I'm going to take a little stroll," replied the young husband. "There isn't another one due until ten-thirty."

The preacher was finishing up his little talk on avarice: "And remember, friends, there will be no selling and buying in Heaven."

That's when an oilfield supply salesman on the back row remarked, "Well, that's not where business has gone anyway."

Out Arkansas way, a man took his dog and lantern for a coon hunt. As he crossed a right-of-way in an isolated area, a train came streaking down the track. The hunter waved his lantern frantically, and when he had stopped the train he asked the engineer, "Do you want to buy a coon?" The engineer's reply is not printable.

"Well," said the hunter, "you needn't of got so excited. I ain't even caught the coon yet."

A tractor salesman approached a prosperous-looking farm where he observed the farmer slowly and painfully guiding a plow drawn by a bull. Thinking that this offered an excellent opportunity for a sale, he pointed out to the farmer the many advantages of a tractor.

To his surprise, the farmer said that he already had a tractor and that it worked fine and was in the barn. When asked why the bull was being used for plowing, the farmer replied: "Son, I aim to teach this critter that there's something else in life besides romance."

Barney says: Lease hounds beware of rural farmer with bulls, tractors, and daughters.

Two beautiful girls happened to get reservations on a Pullman sleeper that was crowded with oil men on their way to a convention. One of them became frightened and locked herself into the drawing room. The other remained cool, calm, and collected.

Elderly lady: "Isn't it wonderful how these service station people know where to set up their pumps to get gas."

Love is blind — so a fella has to feel his way around.

DESIGNED, TESTED AND PROVEN IN THE OIL FIELDS

Screened Air Port

Unexcelled . . . for Outdoor Use

- DRIP PROOF
- VERMIN PROOF
- MOISTURE PROOF
- CORROSION RESISTANT
- FORCED AIR COOLED

All these features of Fieldmaster Ball Bearing Motors have been designed to overcome the rugged conditions of Oil Field requirements.

FIELDMASTER

CHECK THESE OUTSTANDING ADVANTAGES.

Heavy Cast base for alignment, stability, heavy duty, double-shielded, prelubricated bearings, reduces lubrication worries, high grade silicon steel in the magnetic circuit reduces iron losses . . . Wide variety of windings provides triple ratings, dual voltages . . . high torque licks heavy starting problems. High slip is available to take care of reciprocating load requirements encountered in pumping.

Write For Descriptive Literature.

BETHLEHEM SUPPLY CO. TULSA, OKLAHOMA

Manufactured by VALLEY ELECTRIC CORPORATION, St. Louis, 8, Mo.

PIPE 1/8" thru 30"

TESTED AND STRUCTURAL

- SPIRAL WELD
- SEAMLESS
- ELECTRIC WELD
- LAP WELD
- BUTT WELD
- CONTINUOUS

Complete Warehouse Stocks FOR EVERY NEED

Call Foster for all your Steel Pipe. You'll get fast dependable service from pipe specialists, with Shop Facilities for every type of Fabrication.

SEND FOR CATALOG PL-9

RAILS - TRACK EQUIPMENT - PIPE - PILING

L. B. FOSTER CO.

PITTSBURGH 30 • NEW YORK 7 • CHICAGO 4

ATLANTA 8 • HOUSTON 2 • LOS ANGELES 5

- Industry
- People
- News

The Trade PARADE

Grant Acquires Zublin Tools

Grant Oil Tool Company has acquired the Zublin line of drilling tools. Grant has obtained all patents and manufacturing rights for Zublin Differential Bits, Simplex Bits and Drain-hole equipment.

"Manufacturing of Zublin equipment has been transferred to Grant Oil Tool Company's new main plant in Los Angeles," states Grant Vice President A. H. Salvatori, "and sales and service for the Zublin line have been brought into the Grant-MacClatchie sales organization."

Form Puerto Rican Firm

W. R. Grace & Company has formed International Metalloids, Inc., a Puerto Rican subsidiary of Grace Internacional S.A., for the production of ultra-high purity elemental silicon.

The new company has been formed following an agreement, announced earlier in the year, between Grace and Pechiney, the French chemical and metallurgical concern which is already in production of silicon in France.

BJ Sets Up Research Group

A research and development group was set up within the BJ engineering department, according to Garth Nicolson, vice president and general manager of Byron Jackson Tools, Inc.

The group is under the general direction of Ray G. Taylor, Jr., manager of oil field products engineering, and is headed by Simon Tamny, supervisor of research and development. Tamny has a master's degree in mechanical engineering from the California Institute of Technology.

The new group does not concern itself with standard assembly line tools, but concentrates on basic drilling problems.

Forms New Dutch Company

American Cyanamid Company, announced W. G. Malcolm, president, has entered into an agreement with Koninklijke Zwavelzuufabrieken v/h Ketjen N. V. of Amsterdam, Holland, providing for the formation of a new Dutch company, Cyanamid-Ketjen N. V., to construct a plant to manufacture initially certain types of platinum reforming catalyst for sale to the oil industry.

Platinum reforming catalysts find their principal use in the conversion of lower grade fuels into high octane gasolines.

SCHLUMBERGER WELL Surveying Corporation has moved a Louisiana Motor Vessel District from Buras to Venice, Louisiana, to further facilitate service in inland areas. District manager is H. H. Ham. Other motor vessel districts are at Houma and Franklin, Louisiana.

Schlumberger motor vessels serve rigs drilling in the inland waters. These vessels contain complete logging units and living quarters for crews. Some are self-propelled and others are of the barge-type which are towed by tug.

A two-week course in interpretation and analysis of resistivity and radioactivity logging was held for 10 men of the sales department of Welex, Inc. at the research and development laboratory in Houston, Texas. The class was conducted by R. B. Smith. Those who completed the course are shown above: Denzel Williamson, sales engineer, Pauls Valley; L. B. Putman, sales manager, Midland; B. R. Redwine, vice president, Welex of Canada, Ltd., Calgary; W. V. Holcomb, engineering trainee, Odessa; A. N. Taylor, sales engineer, Pampa; D. L. Biles, sales engineer, Hobbs; W. L. Porter, sales manager, Panhandle-North Texas Division, Dallas; R. B. Smith, instructor; F. D. Sawyer, assistant sales manager, Fort Worth; L. M. Wood, sales engineer, Abilene; and B. L. Hays, district manager, Farmington.

Armco Steel Plans to Acquire National Supply

Charles R. Hook, chairman, and Ralph L. Gray, president, of Armco Steel Corportion, and A. E. Walker, chairman, and A. W. McKinney, president, of The National Supply Company, announced that both companies had approved in principle a proposal under which Armco Steel Corporation would acquire The National Supply Company, and the stockholders of National Supply would receive shares of Armco common stock on the basis of 85/100 share of Armco for each share of National Supply.

The Boards authorized their respective officers to negotiate and work out a final contract between the companies.

Armco is the seventh company in the steel industry in ingot capacity, and National Supply is one of the principal producers of oil country tubular goods, machinery and equipment.

Lone Star Steel to Expand

An $8,000,000 expansion program, begun in 1957 and due for completion early in '58, highlights activities at Lone Star Steel Company. The program includes a stretch-reducing mill, bar mill, and another open hearth furnace. President E. B. Germany said the program had been financed entirely out of working capital.

The new stretch-reducing mill will substantially increase Lone Star's supply of tubing. This mill, currently going through "break-in" runs, will use Lone Star's 5½-in. casing, and by a stretching and reducing operation, draw it down to the smaller sizes of tubing such as 2⅜-in.

The new open hearth furnace becomes the fifth in Lone Star's battery.

BJ Wins Award

V. C. Horner, vice president and manager of sales for Byron Jackson Tools, Inc., has received notice that BJ earned an award for their "5500" Hydraplex hook in the Steel Founders' Society of America's Product Development Contest.

The BJ hook is one of the first of the larger, heavier-duty oil well drilling tools designed for today's deep tries.

New Venezuelan Office

The National Supply Company of Venezuela, C. A., has opened an oil field supply store at Barinas, in western Venezuela. This is the company's fourth store, the others being at Maracaibo and Las Morochas in the west and Anaco in the east. R. S. Bernstein is store manager.

ALCO PRODUCTS, INC. completed an oilfield equipment warehouse and office in the Odessa-Midland area. The new facilities to serve the West Texas-New Mexico region, include complete testing and repair service. Headquarters for Alco's Petroleum Industry Equipment Division are in Houston and the main manufacturing plant is in Beaumont. The company also designs and manufactures heat transfer equipment for processing plants and Alco diesel-electric power packages are used for drilling rigs.

Trade Parade

Offers Training Facilities

Philco TechRep Division has announced that it is making the training facilities of the Philco Technological Center available to help meet the manpower shortage in technology.

Prior to this annoucement these training facilities were available only to Philco personnel. According to Robert F. Herr, vice president, Philco Corporation, the decision to make the services of the Center available was made in view of the critical shortage of technical manpower and as a result of many requests from government and industry.

Rockwell Adds Plants

Rockwell Manufacturing Company of Canada, Ltd., has purchased a new 50,000-sq ft plant at Guelph, Ontario, recently vacated by Hammond Manufacturing Company of that city, W. F. Rockwell, Jr., president, has announced.

The modern one-and-a-half-story brick and tile factory will enable Rockwell of Canada to meet increasing demand throughout the Dominion for the wide variety of products manufactured in its existing 92,000-sq-ft plant at Guelph, Rockwell said.

New 180,000 sq-ft plant of Rockwell at Kearney, Nebraska, is now in limited production, Lloyd A. Dixon Jr., vice president in charge of Meter and Valve Division, announced.

Approximately 75 employees are already at work in the new plant, which manufactures Rockwell-Nordstrom lubricated plug valves for the petroleum, natural gas, chemical and other fluid-producing and fluid-using industries.

For the "MR. CAP"
They Chose a

Thompson . . . Perfect for Offshore Work!

On offshore rigs the reclamation of mud is vitally important and the separation of shale and abrasives from drilling muds means a more effective, time and money saving drilling job. Barnwell Offshore, Inc. chose Thompson for their new offshore rig, the MR. CAP, because it was field proven, will give them clean mud and make tools last longer, with a minimu of re-tooling and restoration of mud solution.

A Thompson Separator is your surest bet onshore . . . offshore . . . for shallow, medium and deep wells. The dependable Sample Machine works simultaneously with the separator, giving a foot-by-foot mud analysis with specimens. Write for Folder.

THOMPSON TOOL CO.
IOWA PARK, TEXAS

SOLD ONLY THROUGH SUPPLY STORES

To Acquire Venezuelan Firm

U. S. Industries, Inc. has made arrangements to acquire the assets of Oil Field Sales & Service, S.A., a Venezuelan corporation which distributes and services a wide line of oil field equipment and tools in Venezuela and Colombia, John J. Snyder, Jr., president of U.S. Industries, announced.

Purchase price for Oil Field Sales & Service will be around $585,000, Synder revealed. It consists of 39,506 shares of USI common stock, with the balance to be paid in cash over a period of years out of future profits of Oil Field Sales & Service. Net sales of Oil Field Sales & Service for the fiscal year ended August 31, 1957, amounted to approximately $1.3 million.

Creates New Controls Division

Formation of a new Electronics-Controls Division is announced by Ralph L. Boyer, vice president and director of engineering for Cooper-Bessemer Corporation, Mount Vernon, Ohio.

Anticipated trend to automation of power and compressing operations by pipeline, petrochemical and industrial plants served by Cooper-Bessemer has initiated the company's decision to create this new division, Boyer explains. Within the next 10 years, for example, it is expected that the major gas transmission pipelines in the United States will be automated.

The new Electronics-Controls Division will be headed by Reed D. Hamilton.

Marketing Firm Established

Ramo-Wooldridge Corporation, Los Angeles, and Thompson Products, Inc., Cleveland, have formed a subsidiary corporation for marketing industrial process control equipment.

To be known as Thompson-Ramo-Wooldridge Products, Inc., initial major effort will be on the RW-300 digital control computer, the nation's first process control computer. Offices will be located at Ramo-Wooldridge Center near Los Angeles International Airport.

Names Ad Agency

The Reed Roller Bit Company has named Rives, Dyke & Company as advertising agency for its oil tool division, Kenneth M. Rice, Reed advertising manager, announced.

Reed, a leading manufacturer of rock bits, tool joints and drill collars for more than 40 years, is currently marketing a new three-cone rock bit, known as the Y series. Much of the advertising work to be done for Reed by Rives, Dyke will center around this new product.

Joint Effort on Transistors

Texas Instruments Incorporated signed an agreement with International Business Machines Corporation under which both companies will work together in the area of transistors for data processing machines.

ELECTRO-TECHNICAL LABS, a division of Mandrel Industries, Inc., has acquired the North American Geophysical Company, D. D. Mize, Electro-Tech general manager, announced. Both firms headquarter in Houston.

"North American gravity meters, proved to be fully accurate and fieldworthy, are used throughout the world both on land and underwater, primarily for oil exploration," Mize said.

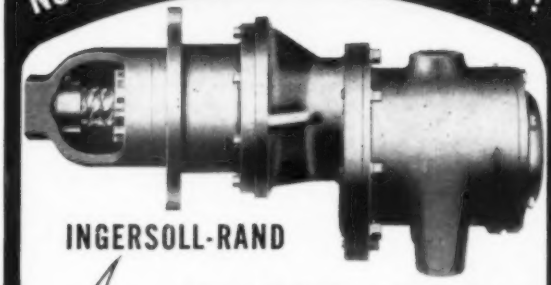
Recent achievements in new product development represent the principal reason why sales of the Oil Center Tool Company this year will eclipse that of 1957, despite depressed activities in the oil industry, W. A. Wolff, O-C-T president, reported at the company's recent annual sales meeting. Wolff stressed that Oil Center Tool, a division of the Food Machinery and Chemical Corporation, is gearing a 1958 sales program based on production of further new products. Inspecting model of new tubing hanger are, left to right, Fritz Richards, vice president; Ross Spencer, sales manager; J. R. Yancy, chief engineer; H. O. Quebe, assistant chief engineer; Dr. Jake Lebeaux, manager of research and development.

Vazca Building Shipyard

Initial marine construction facilities of Vazca at Lake Maracaibo, Venezuela, are nearing completion. The construction and repair yards of the new company will be operated by Levingston Shipbuilding Company of Orange, Texas, a stockholder of Vazca. The name adopted by the new enterprise is an abbreviated form of its full name, Varadero Y Astillero Del Zulia Compania Anonima.

Home of Vazca is a 25-acre shipyard site on the west shore of Lake Maracaibo, Manager Johannes A. Van Den Hoek has indicated that the firm will engage in construction and repair of marine equipment, as well as general fabrication. Van Den Hoek is a native of Holland and a long-time resident of Venezuela.

NO BATTERIES TO WORRY ABOUT!



INGERSOLL-RAND

Air STARTING MOTORS

give you trouble-free engine starts

RELIABLE—I-R Air Starting Motors are built for fast, sure engine starting—anywhere.

LOW COST—No batteries, generators or electrical parts to buy. Practically no maintenance expense.

COMPACT—I-R Air Starting Motors are lightweight, small but powerful. For all popular gasoline and diesel engine sizes. Easily installed.

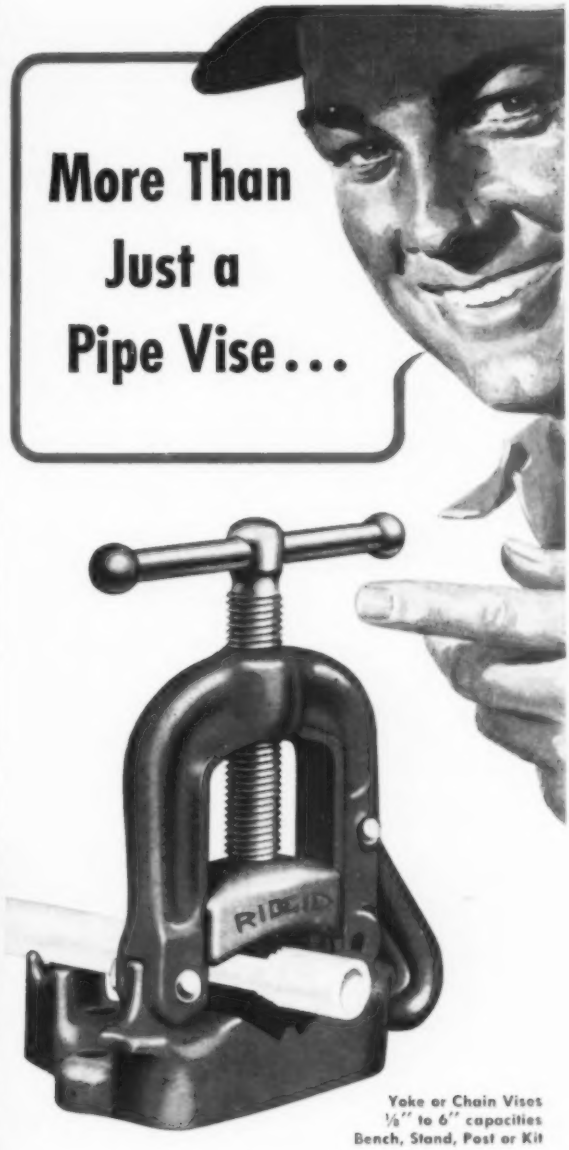
Ask your engine distributor to show you the I-R Air Starting Motor line. Or write for Bulletin 5094A.

18-512

INGERSOLL-RAND

11 Broadway, New York 4, N.Y.

More Than Just a Pipe Vise...



Yoke or Chain Vises
⅛" to 6" capacities
Bench, Stand, Post or Kit

RIDGID

Pipe Vises give you most utility for your money

RIDGID LonGrip jaws take a firmer grip on pipe—and without chewing it up. Most of these vises have handy work-tray bases, pipe rests and pipe benders, doing more for you than merely holding pipe. It pays you to ask for RIDGID at your Supply House.

The Ridge Tool Company • Elyria, Ohio • U.S.A.

Trade Parade

Motorola Inc.: Homer L. Marrs has been appointed vice president and operations manager of Motorola Communications and Electronics, Inc., and Harold A. Jones, former staff director of sales, has been elected to succeed Marrs as vice president and Midwestern area sales manager. Marrs will manage the nationwide sales engineering activities of the broad Motorola Communications product line, and Jones will be in charge of the Midwestern sales area, bounded by and including North Dakota, Kansas, Kentucky, Ohio and Michigan.

Marrs will have his office at executive headquarters, 4501 W. Augusta Blvd., Chicago, while Jones will work from the recently occupied Midwestern area sales office building, 4900 W. Flournoy St., Chicago.

Richard G. Jones was made district manager, Western Area, for Motorola's microwave and industrial control products. He will direct microwave sales activity in the 10-state Western area from Motorola's Burlingame, California, office.

Mueller Company: Dan R. Gannon has been appointed general sales manager with headquarters at Decatur, Illinois. He joined Mueller in 1929 as a sales representative, moving up to field sales manager in 1957.

National Supply Company: Karl J. Digel, division sales representative in Chicago, has retired after 36 years' service with the company. He joined National Supply in 1921 as a salesman working out of Tulsa, Oklahoma, and covered oil fields from the famed Spindletop Field at Beaumont, Texas, to the Turner Valley Field near Calgary, Alberta, Canada. Digel represented National Supply at all of the Tulsa oil shows.

Petrolite Corporation: Louis T. Monson, presently chief chemist of the division and a 32-year man, was named vice president of Petrolite and general manager of its Tretolite Company of California Division. Glenn W. Camblin who held the position, announced his retirement after more than 33 years of service in the Tretolite organization. Both men joined the Tretolite organization when it was operated as Wm. S. Barnickel & Co., Camblin in 1924 and Monson in 1926.

Replacing Monson as manager of Tretolite Company of California Laboratory is Woodrow J. Dickson, who has been engaged in demulsifier research and development for Tretolite for 20 years.

Philco Corporation: William Balderston, chairman of the board, retired from the company after 26 years of loyal and distinguished service. From 1946 to 1948, he served as executive vice president of Philco, and was elected president in 1948. He became chairman of the board in August 1954.

Michael J. James was promoted to assistant manager of Purchasing, Government and Industrial Division. James replaces John R. McAllister who was recently named Manager of Purchasing.

Reed Roller Bit Company: L. C. (Cliff) Beasley, salesman formerly operating out of McAllen, Texas, has been transferred to the Export Division. He joins Reed salesman A. J. Organ in Maracaibo, Venezuela.

Rockwell Manufacturing Company: Pat H. Luckett, sales manager of Instrument Division, Tulsa, Oklahoma, has been promoted to assistant product manager-gas products for the company's Meter and Valve Division with headquarters in Pittsburgh. The Instrument Division sales and service groups and products are now part of the nationwide gas products sales setup in the Meter and Valve Division.

Mid-Continent Supply Company: New general office and personnel manager is J. P. Jones, former assistant to general division manager, and new assistant general manager of sales is J. H. Kenyon, formerly in the Machinery Division.

Allis-Chalmers Manufacturing Company: E. R. Danielson is now assistant to W. M. Wallace, vice president and general manager of the General Products Division. R. E. Morris, manager of industrial sales for the Industries Group in Washington, D. C. office became manager of the Group's St. Louis district succeeding J. C. Lovelace, resigned. W. P. Bell was made manager of Industries Group sales in Washington. He had been manager of national defense sales for the Group.

Babcock and Wilcox Company: J. Roy Gordon, widely known Canadian and American industrialist and metallurgist, was elected to the Board of Directors. He is executive vice president, a director and member of the executive committee of International Nickel Company of Canada Ltd, and is executive vice president and director of International Nickel Company, Inc.

Baroid Division, National Lead Company: Recent appointments include: Wendell H. Russell as area superintendent for Texas Gulf Coast Area with headquarters at Corpus Christi; William G. Bealmear as sales representative in the Baroid export department in Houston; William R. Underwood, formerly Louisiana sales representative at Dallas, to Houston sales office; Joseph K. Meagher, formerly district sales representative at Ardmore, Oklahoma, to Dallas; Billy R. Fry as sales representative in the Tulsa Mid-Continent office; Robert L. Valerius, previously Liberal store manager, to district superintendent, replacing Fry.

Mission Manufacturing Company: Richard E. White, who has been with the company since 1938 when he joined as a junior engineer, has been elected president. Until White's election, Walter B. Sharp served as both president and chairman.

Dresser Industries, Inc.: R. E. Reimer was elevated to executive vice president and will also continue to serve as treasurer. John Lawrence was also named as an executive vice president. Thomas L. Moody was appointed vice president in charge of industrial relations. J. Douglas Mayson succeeded Reimer as secretary and Cecil C. Hill and Paul E. Brodrick, were made assistant treasurers.

Reimer has been with Dresser since 1929, serving as comptroller and treasurer, being elected vice president in 1947 as well as holding the offices of secretary and treasurer.

Lawrence recently resigned as president of Joy Manufacturing Company, to join Dresser's organization as a vice president. Before his association with Joy, Lawrence completed a seven year career with SKF Industries as vice president of engineering, research and manufacturing. Moody moves into a vice presidency after 15 years as Dresser's director of industrial relations. He served as labor relations attorney for the Railway Express Agency, then was appointed Director and General Counsel of the State Authority of Georgia.

Walter L. Haning was promoted to chief sales engineer of Security Engineering Division. He formerly was chief field engineer for this Dallas-based manufacturer of rock bits.

Bud Arnold Barker has been appointed district manager of Western Venezuela for Security Engineering Division. He has for years worked with various top drilling contractors in the United States and during the past several years has been in Venezuela engaged in similar activity.

Newly-appointed executive vice president, covering all Security activities except sales, is John C. Helies, who formerly for three years was associated with Dresser Industries. (Still executive vice president in charge of world-wide Security sales is A. M. Birnie.) Helies, prior to his association with Dresser, was general manager of one of the divisions of General Electric Company. Henry L. Sisk has been named Security's manager of industrial relations. He, too, formerly was with Dresser, the parent company, as a staff assistant on industrial relations.

John A. Roebling's Sons Corporation (subsidiary, Colorado Fuel and Iron Corporation): E. George Hartmann has been elected vice president-sales and will be located at the corporation's main office in Trenton, New Jersey. Prior to his appointment, Hartmann was general product manager of the Wire and Cold Rolled Products Division. He has had over 37 years' experience in the wire industry.

The Ruberoid Company: Thomas H. Dermody, comptroller, has been elected vice president and comptroller. Dermody, who will continue to make his headquarters in South Bound Brook, New Jersey, has been comptroller since 1943.

Schlumberger Well Surveying Corporation: William J. Gillingham, who joined the firm only five years after the corporation's first electric logging project in this country in 1929, was named president of the firm with Houston headquarters. He was executive vice president and follows Pierre Schlumberger, who has been president since 1946. This change will allow Schlumberger to devote full time to his duties as president of Schlumberger Ltd. Born in England in 1912, Gillingham was graduated from the Royal School of Mines in 1933 with a degree in Petroleum Technology. He joined Schlumberger in 1934.

W. G. (Bill) Graves was named sales engineer for Arkansas. He will be stationed in Magnolia, Arkansas.

Minneapolis-Honeywell Regulator Company: Walter W. Finke, president of the Datamatic division, has been elected a vice president of the corporation. Finke will continue as head of Datamatic, which is producing large-scale electronic data-processing systems in the $2½-million category for office automation.

Lone Star Steel Company: Bill Bohannan was named "Salesman of the Year" for 1957. E. B. Germany, president, presented him a plaque at the company's annual sales meeting.

McCollough Tool Company: Jim Helmer, formerly in the Logging Department at Los Angeles, was made sales representative at Bakersfield; Olin McGrew, sales representative, formerly at Kimball, Nebraska, was transferred to sales in Four Corners District, with headquarters at Durango, Colorado; and Jim Dotson, former serviceman at Kimball Branch, was promoted to sales representative in same area.

Personals

Carrier Corporation: William H. Macdonald is assistant manager of the machinery department, a new post. Succeeding him as product specialist of industrial air and gas compressors at Syracuse, New York, is Frank M. Fives, who was senior sales engineer for this equipment in the New York regional office. Clark T. Shields moves from Chicago office to take over sales of these products throughout the northeast.

Cooper-Bessemer Corporation: Woodrow W. Waligore was appointed to the Odessa branch office as a sales engineer.

W. R. Grace & Company: Robert D. Goodall and H. B. DeVinny have been appointed vice presidents of the Davison Chemical Company Division. Goodall, who has been general manager of petroleum catalysts, becomes vice president and general manager of the Chemicals Division, one of Davison's three operating groups. He succeeds F. C. Nicholson, who will assume increased responsibilities in connection with major development projects of W. R. Grace & Co. in the international field, which are now under active negotiation.

DeVinny, previously director of industrial and public relations, becomes vice president with the same responsibilities.

International Nickel Company: Albert P. Gaenebin and L. E. Grubb were named assistant vice presidents. Gaenebin continues as manager of the Nickel Sales Department. Grubb, who has been general superintendent of the Huntington, West Virginia, works of International Nickel since 1953, will be in charge of labor relations at all United States plants from New York.

Jones & Laughlin: Ralph D. Hilborn, has been appointed to the newly-created position of division controller of the Supply Division, Tulsa, Oklahoma. He was chief accountant.

B. E. Irby has been appointed local store manager at Longview, Texas.

S. M. Jones Company: W. H. Ritterbusch, Jr. was advanced to Northern Division Sales Manager with territory covering oil producing states north of the Red River and including Canada. He joined the firm in 1946 and served as manager of the Field Engineering Department. Charles W. Turner was appointed Southern Division Sales Manager, the immediate supervisor of district representatives at Midland, Dallas, Wichita Falls, and Houston, Texas, and Shreveport, Louisiana. Both will headquarter at Tulsa.

Chicago Bridge & Iron Company: Fred Kouka is new manager of the company's foreign erection division with headquarters in New York. Hugh Minter has been transferred to the Tulsa sales office from the general sales office, Chicago, and Robert Hull moved from foreign erection to foreign sales department, New York.

F. H. Maloney Company: James H. McBrien was appointed vice president, sales. He joined the company in 1957, as general sales manager.

Anthony S. Girala was advanced to vice president, research, from the position of development engineer. He established the original research lab in the company.

Cardwell Manufacturing Company: Charles C. Hamblin is new advertising manager in Wichita, Kansas. He was formerly associated with the International Harvester Company sales division. He attended Washington University.

Use low-cost

CONCENTRATED

BORASCU®

WEED KILLER

wherever weeds and grasses are a FIRE HAZARD!

Your "grassing" costs can drop as much as 80% when you use this weed killer! Savings in man-hours alone can be impressive when you consider that year-long results come from just one easy, DRY application of powerful Concentrated BORASCU. This granular, inorganic herbicide **destroys** most vegetation and **prevents regrowth** for long periods because it **remains active** in the root zone; satisfactorily meets all your requirements for safety.

NOTHING TO MIX

NO WATER TO HAUL

NONPOISONOUS

NONCORROSIVE TO FERROUS METALS

Want details? Write... **United States Borax & Chemical Corporation**

PACIFIC COAST BORAX COMPANY DIVISION

630 SHATTO PLACE, LOS ANGELES 5, CALIFORNIA

DISTRIBUTORS LOCATED THROUGHOUT OIL FIELDS OF U.S.A., CANADA, MEXICO, COLOMBIA, VENEZUELA.

Trade Parade

Halliburton Oil Well Cementing Company: Grover Kilgore, vice president for sales and advertising, announces a lateral transfer of duties between the firm's sales and advertising managers. Lloyd H. Lawrence, former Halliburton sales manager, is replacing Ed Trapp as the company's advertising manager. Trapp is taking over Lawrence's former position and will become the new sales manager. The job switch is described by Kilgore as part of the Halliburton training program.

Walworth Company: Leo I. S. Conway is new assistant manager of the Metropolitan division with headquarters in Harrison, New Jersey. He joined Walworth in 1954 as a salesman in the Manhattan, New York, area.

Westinghouse Electric Corporation: New executive assignments include: Gwilym A. Price, who has been president since 1946, and chairman since 1955, becomes chairman of the board. Mark W. Cresap, Jr., executive vice president and a director since 1955, was elected president, and chief administrative and operating officer. E. V. Huggins, who has been vice president-corporate affairs and corporate secretary, becomes chairman of the executive committee of the board and vice president.

John K. Hodnette, vice president and general manager and a director since 1955, was elected executive vice president. George G. Main, treasurer since 1949, retains that position and also becomes vice president-finance. Francis E. Dalton, director, corporate accounting since 1949, was elected controller.

Houston Oilfield Material Company: Transfers and promotions include: P. J. Bedford from Brookhaven to Hattiesburg as sales and service representative: M. R. Brenek from E. W. S. supervisor to field maintenance engineer, Houston; L. R. Denham from Denver to Casper, Wyoming as city salesman; Wm. H. Dodson, Jr., from Kimball, Nebraska, to Bay City, Texas; B. M. English from Casper to Denver, Colorado, as city salesman; C. J. Erwin from New Orleans to New York City as export manager; J. E. Kerr from assistant division manager to division manager, New Orleans; Gerald Shoemake, from Pearsall to Liberty, Texas; R. C. Unger, Jr. from Liberty to Bay City, Texas; M. B. Watson from Alice to Sam Fordyce, Texas; Roy N. Young from Corpus Christi to Casper, Wyoming.

A. O. Smith Corporation: At its annual meeting in Milwaukee the board re-elected all of present officers. In addition, in recognition of the growing importance of a number of key functions, the Board named 11 executives as new vice presidents.

Four new vice presidents will continue to function as members of the management staff, in the following areas: M. E. Morgan, procurement; W. W. Higgins, engineering; S. E. Wolkenheim, marketing; R. F. McGinn, research and development.

There are two new operating vice presidents: J. H. Brinker, who has been in charge of Permaglas consumer products at Kankakee, Illinois, and will continue in that position, and John S. Randall, who will be in charge of Industrial Products.

Five regional managers have been elected commercial vice presidents for their respective areas. They are W. W. Stake, New York, eastern region; George P. Hough, Chicago, midwestern region; L. M. Keating, Houston, southwestern region; Allen O. Dragge, Los Angeles, Pacific Coast region; Walter H. Porth, Milwaukee, in charge of relations outside the United States.

Delta Tank Manufacturing Company: Ronal A. Boze was named sales engineer in the Westwego, Louisiana, oilfield equipment division office.

Ethyl Corporation: B. B. Turner, president, was designated chief executive officer of the company. Edward L. Shea, formerly chief executive officer, will continue as chairman of the board of directors. Turner has been president since 1956, prior to which he served as executive vice president. Shea was named board chairman in 1956, after serving as president since 1947.

Solvay Process Division, Allied Chemical & Dye Corporation: Wilbur H. Brumfield and Cortez P. Hackett were elected vice presidents. In his new assignment, Brumfield will assume increased administrative and executive duties in the New York office. As vice president in Syracuse, Hackett will be in charge of all Solvay's operating and development department functions.

Clyde A. Kitto was named to post of director of operations, Arnold Hanchett to director of development, and M. James Campbell to manager of Solvay's Syracuse plant. John B. Green was named comptroller, succeeding John J. Bryers.

H. G. Phillipps, Jr., was appointed manager, Syracuse sales branch, succeeding William E. Hess, retired.

Technical Oil Tool Corporation: J. Phillip (Phil) Fouche has recently rejoined the sales and service staff in the Abilene-Sweetwater area, with Abilene as headquarters. He was with Totco for five years and has recently been in the pipe business.

Worthington Corporation: Admiral Arthur W. Radford, former chairman of the Joint Chiefs of Staff, was elected a member of the Board. Admiral Radford recently retired from the Navy after 45 years of distinguished service.

George Steven was appointed assistant general manager of the Compressor and Engine Division in Buffalo, New York. Harold W. Whiting succeeds Steven as manager of engineering.

Black, Sivalls & Bryson, Inc.: E. L. McCarthy has been named manager of Oilfield Engineering, heading the staff, headquartered at 1708 West Main Street, Oklahoma City. He joined BS&B in 1949 as a research engineer. He succeeds Lawton L. Laurence, recently elected engineering vice president.

Oil Well Supply Division of U.S. Steel: Lawrence C. Armstrong, Jr., was made area manager, engine and compressor sales at Houston. Armstrong was employed by "Oilwell" in 1953 as quotation and pricing specialist at Oil City, Pennsylvania, and was transferred in 1955 to Garland, Texas.

William W. Eggleston is new district representative at Corpus Christi, Texas. He was formerly field representative at the Corpus Christi store.

B. J. Travis was appointed assistant district engineer, secondary recovery sales, at Midland, Texas.

Security Engineering Division, Dresser Industries: Vernon Mitchell, export representative, has returned to United States after seven months visiting many of the world's most active centers of oil exploration and production.

CONSOLIDATED ELECTRODYNAMICS Corporation and The Solartron Electronic Group, Ltd., of Surrey, England, have signed a licensing agreement under which the British company will manufacture and market CEC magnetic-tape recording and reproduction equipment for use in aviation research and development and in flight trials of guided missiles and aircraft.

PURCHASE OF A MACHINE SHOP in Duncan, Oklahoma, was recently announced by Acme Oil Tool Company of Texas, Inc., formerly the Wichita Falls Fishing Tool Company and an affiliate of Acme Oil Tool Company, Inc., whose home offices are in Oklahoma City. The Duncan machine shop, formerly owned by MCM Machine Works, will continue to offer repair work on light and heavy oil field equipment under its new management.

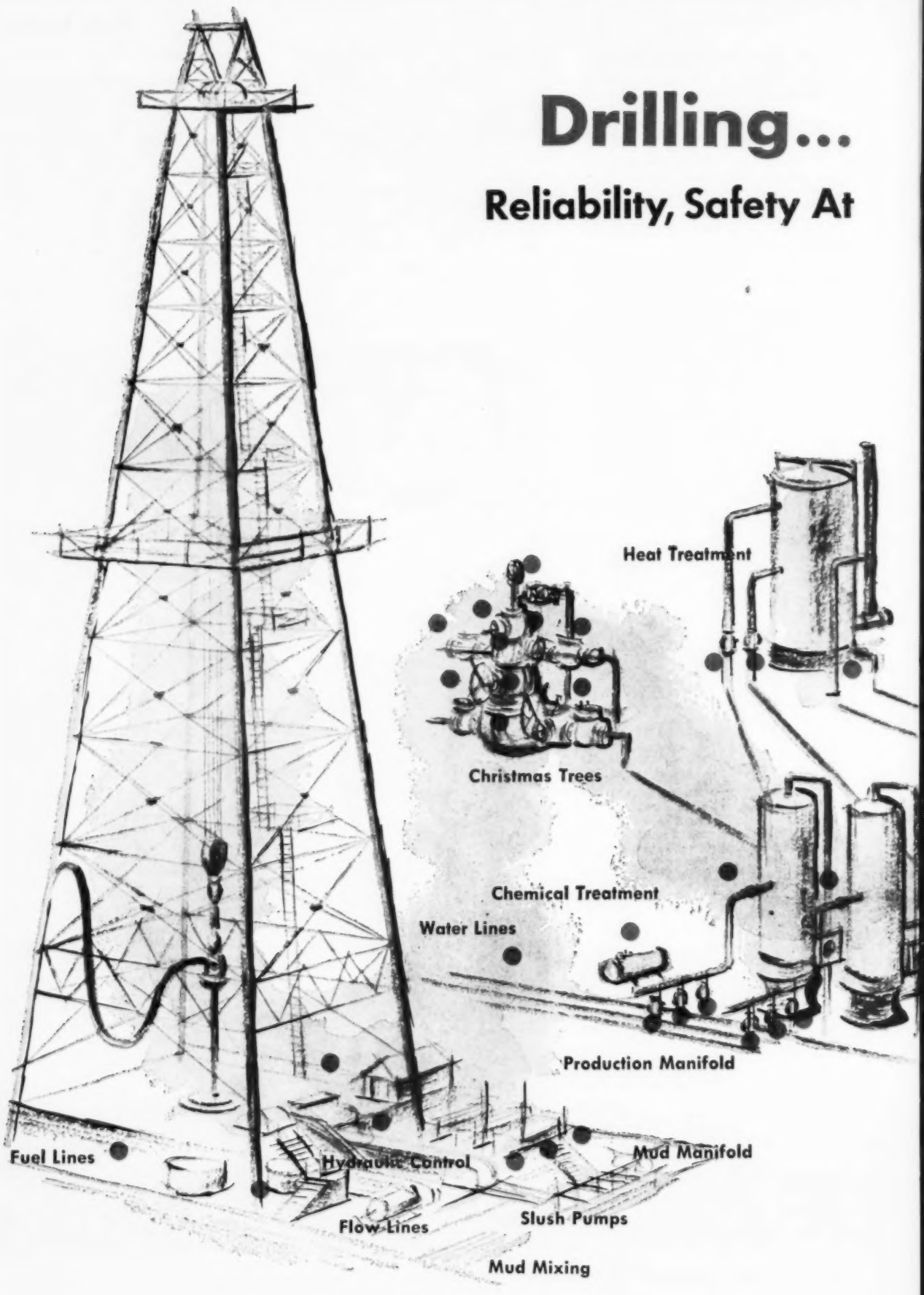
Bill McFarland, president of Acme also announced that the Great Bend Fishing Tool Company is no longer affiliated with Acme Oil Tool Company.

FORMATION OF A NEW COMPANY, Corrosion Control Products, was announced January 1 by W. F. McNaughton, corrosion sales engineer. According to McNaughton, who has been vice president and sales manager of Plicoflex, Inc., the new company will be exclusive factory distributors for Plicoflex laminated tapes and asphalt coating and pipeline coating and engineering insulating spacers and Plico asphalt coatings for the southwest region. V. E. Pinkston will be associated with McNaughton. The firm will headquarter in Long Beach, California.

ARCCO
ARCCO-Anubis
LIQUID GRAVITOMETER
For PIPELINES, REFINERIES, GASOLINE PLANTS
NOW 19 MODELS
MODEL R
This ruggedly built instrument of laboratory accuracy is ideal for quick checking and for continuous recording of Specific Gravity of liquids under line pressure. Changes in Specific Gravity of sample are recorded with a very minimum of time lag. Foreign liquids and gases are automatically purged from sample. No moving joints or stuffing boxes to cause friction or leakage. Temperature corrected, this precision instrument is adaptable to high pressures. Hundreds are in daily use in plants and refineries of major companies. Available in 19 Models for Recording, Signalling, Transmitting and Controlling. Send for Bulletin 111R-3.
AMERICAN
RECORDING CHART CO.
1113 E. 11th St. • Los Angeles 23, Calif.
AVAILABLE FOR EARLY DELIVERY
Send for Bulletin 111R-3

Drilling...

Reliability, Safety At



Completion...Production

Every Step With ROCKWELL-Nordstrom VALVES

Field men depend on Rockwell-Nordstrom valves for reliable, safe flow control. They know that Rockwell-Nordstrom exclusive Sealdport* lubrication assures leakproof, positive shut-off and instant, quarter-turn operation that can't be had in ordinary valves.

The dependability of Rockwell-Nordstrom valves has been proved by forty years of service throughout the oil and gas industries. They can't be matched from any standpoint, yet they cost no more to buy, often less than ordinary valves. For more information, call your supplier or write: Rockwell Manufacturing Company, Pittsburgh 8, Pa.

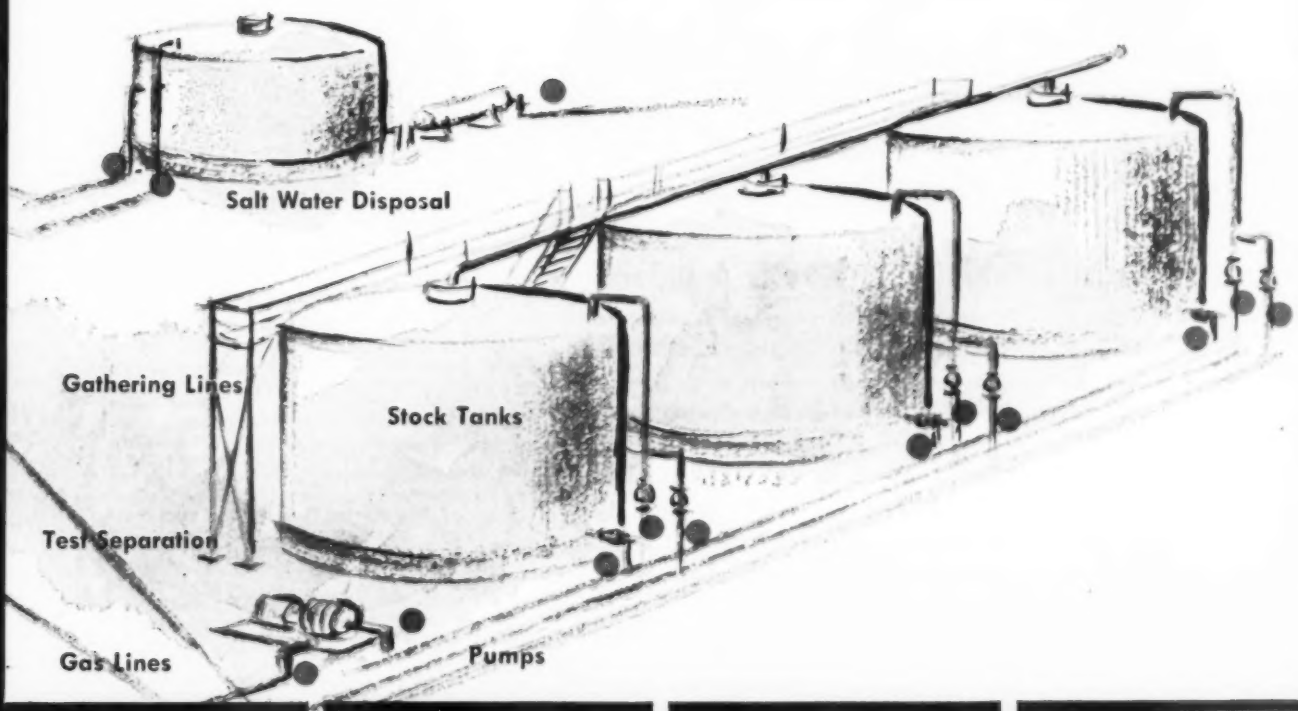
Canadian Valve Licensee: Peacock Brothers Limited.

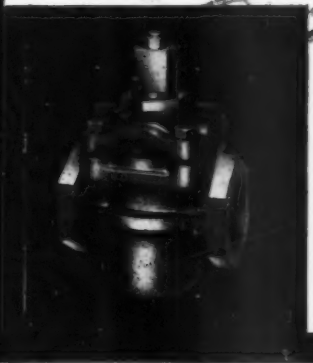
*Registered trademark Rockwell Manufacturing Company

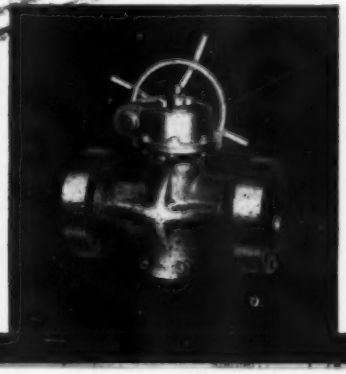
ROCKWELL-Nordstrom VALVES

it's ROCKWELL

MANUFACTURING COMPANY







Trade Parade

Alan Wood Steel Company: Robert A. Lubker moved to the position of director of research. He is presently associated with the Armour Research Foundation of the Illinois Institute of Technology, Chicago, in the capacity of manager of Metals Research.

Clary Corporation: W. R. Beall was promoted to manager of sales for the Electronics Division. Beall, formerly a sales engineer, heads a technical sales group which will work with present data processing equipment distributor organization.

Consolidated Electrodynamics Corporation: Martin V. Keibert, formerly director of electronics for the Miami Shipbuilding Corporation, joined Datalab, a division of Consolidated Electrodynamics as proposals coordinator. A former Navy commander, Kiebert was head of the Special Weapons Branch of the government's Bureau of Aeronautics during World War II. In this capacity, he was responsible for all of the bureau's electronic activities in guided missiles. Joseph M. Martin, Sr., was named manager of the design department, and Paul L. Ashway was appointed manager of fabrication services of Datalab.

Caterpillar Tractor Company: Walter H. Zurhorst was named plant engineer, Manufacturing, General Office. Succeeding Zurhorst as Peoria plant engineer will be Harry R. McNeely.

Enjay Company, Inc.: Jack Arnold, Jr., was appointed supervisor of the Boston office at 135 Clarendon Street.

Leland Equipment Company: W. Wayne Hood was elected vice president in charge of sales with headquarters at Tulsa, Oklahoma. Re-elected to their former positions at the meeting were W. R. Borgman, president, A. C. Beckner, vice president, John E. Timberlake, secretary-treasurer.

Hood was in charge of sales for Leland in southeastern Oklahoma. Leland is a distributor of heavy construction equipment, representing Blaw-Knox, Cedarapids, Cleveland Trencher, Construction Machinery Company. Gardner-Denver, Thew Lorain and Tulsa Winch, etc.

Beckman Instruments, Inc.: Robert S. Rosenast was made production manager for Beckman Instruments' System Division at Anaheim, California. A. C. "Bud" Knudsen was promoted to the position of product line manager, Controls.

Bethlehem Supply Company: C. R. Zimmerman, executive vice president since 1948, will succeed G. A. Tompson as president, who retired January 1. Zimmerman was first employed by Bethlehem Steel in 1927 in the pipe mills of the Sparrows Point plant. He became assistant chief inspector and then special representative in the mills, and in 1938 was transferred to the general offices at Bethlehem as a salesman in the pipe division. He joined Bethlehem Supply in 1947 as assistant to vice president, and was appointed executive vice president the following year.

Tompson has been president since 1948. He has been a leader in industry and civic work in Tulsa.

Christian Seger, Jr., who began in 1938 with Bethlehem Supply, was made vice president and treasurer. Harry A. Wilson was appointed Assistant to President. Wilson joined the firm in 1937 as purchasing agent.

Texas Instruments, Inc.: Patrick E. Haggerty, executive vice president, has been notified by the directors of the Institute of Radio Engineers of his election as a Fellow of the institute. Award of the fellowship was based on Haggerty's "dynamic and inspiring management of the electronics activities of his company and his large personal part in leading the technical efforts of Texas Instruments."

Chain Belt Company: O. W. Carpenter, formerly vice president, Construction Machinery and Finance, is now executive vice president. W. C. Messinger, was promoted to vice president, Construction Machinery Section, from manager, Construction Machinery Division, Milwaukee. E. M. Rhodes was made vice president, Industrial Equipment Section. G. H. Woodland, new vice president, Marketing, is advanced from general sales manager, Industrial Equipment Section.

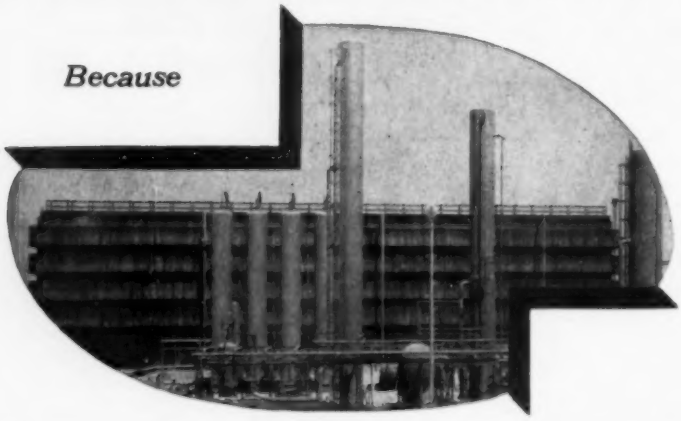
M. W. Kellogg Company, subsidiary of Pullman Inc.: C. C. King is new manager of the Process Engineering Department. He has been associated with the company since 1939 and was made Manager of the Chemical Process Division in 1952. H. C. Pitcher was promoted to construction manager, in charge of all Canadian and South American construction for Kellogg subsidiaries. Dr. Heinz Heinemann joined the firm's research department staff to assist in planning technical coordination and long range research. He will work with Dr. Alex G. Oblad, vice president in charge of Research and Development.

New assistant vice presidents of sales are: M. J. Carnesale, for portions of the United States and all of Central and South

(Continued on page 24)

Your Plant Water Systems
MORE EFFECTIVELY PROTECTED

Because



In Corrosion Inhibitors There Is A Difference

A difference which can be used to your advantage is present in the chemical composition and behavior of Haering's Organic Chrom Glucosates*.

A Chrom Glucosate* inhibitor film is tough, tenacious, elastic yet adherent, self-sealing and impervious. Is particularly effective in waters with high sulfate and chloride contents** or where process streams introduce various complex reducing contaminants. The organic Glucosates are used at low dosage rates over wide ph range. No more expensive and often cheaper to use.

Without cost or obligation find out how "Organic Methods" can provide extraordinary protection to water-using equipment in your plant.

**In use 8 years in a Cooling System where chloride content exceeds 25,000 ppm at times.

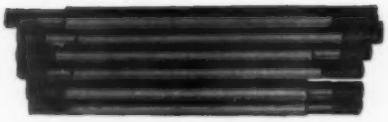
*Reg. U. S. Pat Office

Call or write

WE READ WATER H-O-H ESTABLISHED 1931 OVER 25 YEARS OF SERVICE

D. W. HAERING & CO., INC.
ANALYSTS · CONSULTANTS · MANUFACTURERS
P. O. Box 6037
SAN ANTONIO, TEXAS

Pump rods hard-faced by ThermoSpray Process give 20 times longer service



New Metco Process hard-faced acid sludge pump rods serve as much as 20 times longer than unfaced rods.

A number of oil companies are making important savings in equipment down-time and replacement part costs with the METCO THERMOSPRAY* Hard-Facing Process. Typical of these parts are pump sleeves, as well as the acid sludge pump piston and rods shown here. Operating conditions were severe—rods had to be replaced every 24 hours—new packing every 8 hours. Hard-faced rods now last over 500 hours; packing more than 60 hours. Coatings are extremely dense and non-porous—homogeneous.

The THERMOSPRAY Hard-Facing Process consists of spraying specially developed alloys in powder form with the METCO THERMOSPRAY GUN. No compressed air is required. Coatings have hardness of Rc 30 to Rc 65, depending on the specific THERMOSPRAY alloy used; will outwear hardened steels from 3 to 10 times. Spraying speeds are higher—8 to 10 lbs. per hour—and deposit efficiency far greater (up to 97%)—than with any other type of available equipment. Hard surface depth can be closely controlled and the smooth surface left after spraying requires a minimum of finishing.

Write today for free descriptive Bulletin 126A or a call by a full-time, company-trained, Metco Field Engineer in your territory. Or see your local metallizing job shop.

The following trade names are the property of Metallizing Engineering Co., Inc.: METCO, ThermoSpray.*
**Reg. U.S. Pat. Off.*

Metallizing Engineering Co., Inc.
1149 Prospect Ave., Westbury, L. I., New York · cable: METCO
In Great Britain: Telephone: EDGEWOOD 4-1300
METALLIZING EQUIPMENT COMPANY, LTD.—Chobham near Woking, England

Pipelines and Refineries DEPEND on

Line Scale Long Service

VALVES and SEATS!

For all reciprocating pumps, regardless of size, age, or model . . . in Bronze and Stainless Steel to meet every need, providing long service at pressures up to 1,500 P. S. I. and temperatures up to 300°F. Special sizes on request.

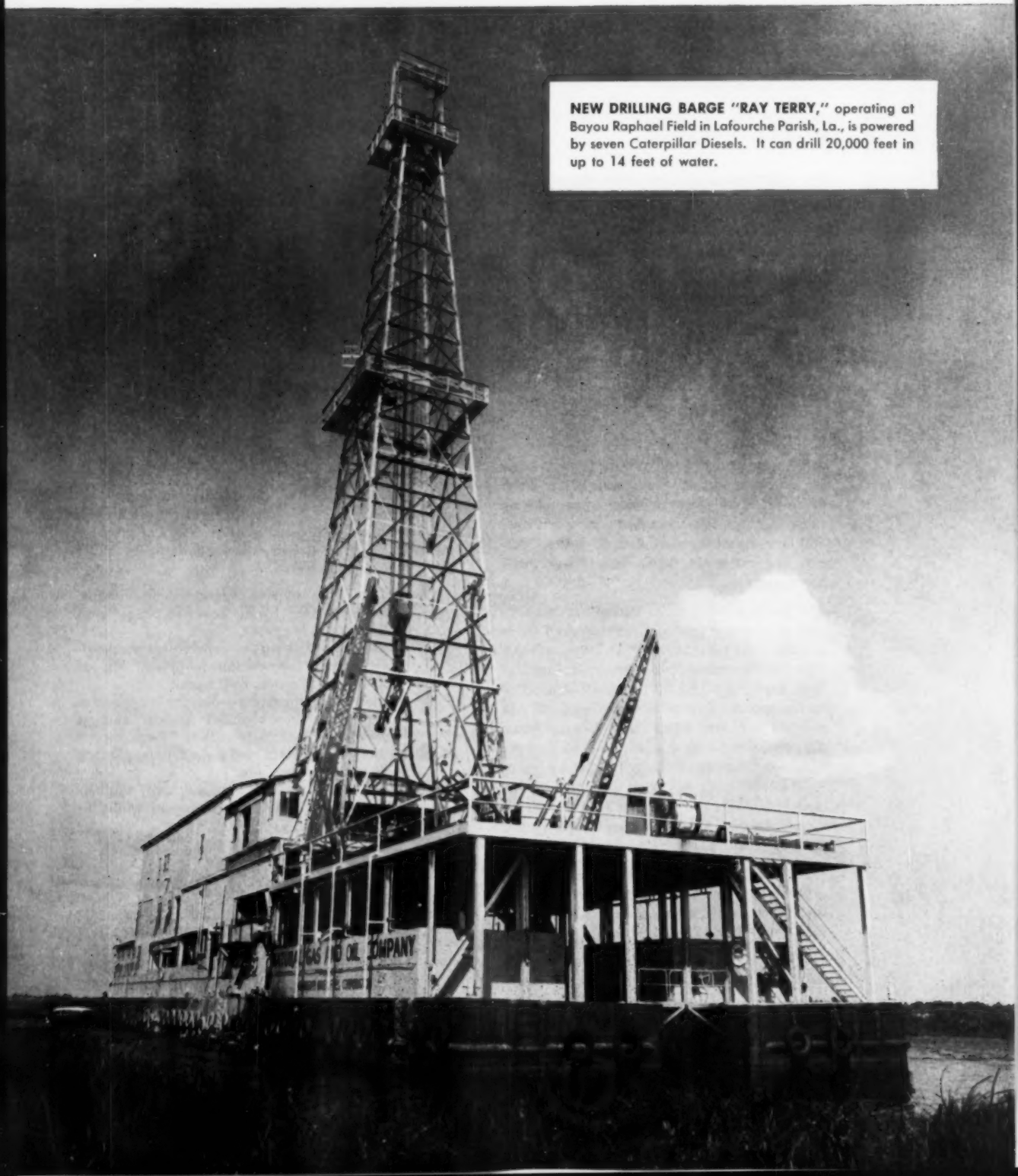
- **Nylon Plate** — Insures long life in all fluids, except Phenol, Formic Acid or Concentrated Mineral Acids.
- **Cone Type Spring** — Fully corrosion resistant; cone construction lengthens life of spring, eliminates coil wear.
- **Double Seating Area**—Seating on shoulder and outer rim provides greater seating area and less deformation area.
- **Reversible Valve Plate** — Offers a bonus of double valve life.
- **Quick Change** — Keeper and retainer design provides quick change of spring or valve without use of any tools.

NEW 1957 CATALOG AVAILABLE!

Send for YOUR Copy . . . TODAY!
(Complete with Price Lists)

Line Scale COMPANY, INC.
2734 S. HIGH STREET
OKLAHOMA CITY, OKLAHOMA

HOW THE "RAY TERRY" CUTS COSTS AND BOOSTS EARNINGS



NEW DRILLING BARGE "RAY TERRY," operating at Bayou Raphael Field in Lafourche Parish, La., is powered by seven Caterpillar Diesels. It can drill 20,000 feet in up to 14 feet of water.

ENGINE POWER BY CATERPILLAR

Ask the owners of the new 215-foot drilling barge, "Ray Terry," why they selected CAT* Diesel Electric Power and they'll give you hard dollars-and-cents reasons. Like this:

"From past experience we find Cat Oilfield Engines are the cheapest per continuous rated horsepower." That's straight from Mort Squires, assistant general superintendent for Natural Gas & Oil Company, which owns the inland drilling barge.

But just as important, the flexibility of these powerful, compact units helps assure maximum earnings. Four D397 Diesels with DC generators are compounded to drive Ideco drawworks and Emsco mud pumps. Power from these electric sets is easily directed anywhere it's needed. And, with four units, the barge loses only 25% power when an engine is shut down for maintenance. If there were just two larger units, fully half the power would be lost from down time on either one.

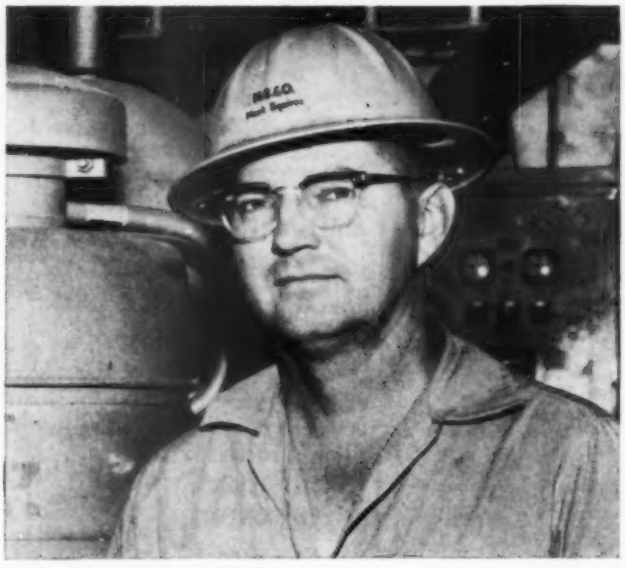
In addition to these four diesel-electric units, the "Ray Terry" has two D397 Turbocharged Diesel Electric Sets for auxiliary AC power and a D337 driving an Emsco pump.

Caterpillar* performance sold these engines. Their heavy-duty design has given them a reputation for dependability, low operating cost and minimum down time throughout the world. Rig owners choose the Cat power plant proven best for their needs. A full line of these four-cycle engines is available up to 650 HP (maximum). Matching generators provide up to 350 KW. When selecting your oilfield equipment always specify Cat Power.

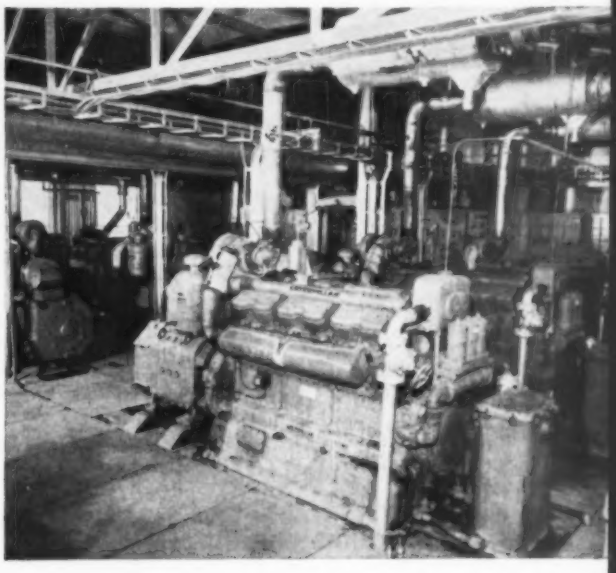
Engine Division, Caterpillar Tractor Co., Peoria, Ill., U.S.A.

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

MORT SQUIRES, assistant general superintendent, reports, "We find Caterpillar Engines are dependable and economical. From past experience, we find they are the cheapest per continuous rated horsepower."



FOUR COMPACT D397s with DC generators drive Ideco drawworks and Emsco mud pumps on the "Ray Terry." These dependable turbocharged oilfield engines give the barge more flexible power at low operating cost.



Cylinder liners typical of quality in Cat Engines

Full-length, wet-type liners in all Cat Engines are "Hi-Electro" hardened to provide extra-long liner and ring life. Direct contact of liner and coolant assures proper operation for many thousands of hours.

Dept. PE2, Engine Division
CATERPILLAR TRACTOR CO., Peoria, Illinois, U.S.A.

Send me more information about Caterpillar Diesel Engines. I have checked the proper box to guide your selection of material.

- ☐ I would like detailed information, as I may be in the market for a Cat Engine or Electric Set. I understand I am under no obligation.
- ☐ I am interested in learning more about these engines.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

America; W. T. McCay, for Mid-Continent and Gulf Coast area; J. A. Petrie, for Eastern Hemisphere and Canada.

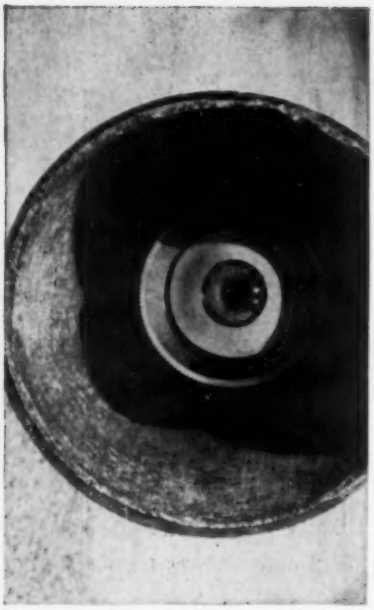
Operational vice presidents appointed are: L. J. Kelly, engineering; H. R. Schuster, procurement; J. W. Smith, construction; F. E. Johnson, Jr., contract operations.

The Foxboro Company: Robert L. Wroe, formerly in charge of accessories promotion with the service and repair division, is now an instructor in the Training Center at Foxboro, Massachusetts. His appointment brings to five the number of full-time staff members of the Training Center.

General Electric Company: G. Frank Reed is the firm's new regional manager for mobile radio and other communication equipment to be sold in the oil, pipeline and drilling fields in Texas, Oklahoma and part of New Mexico. Formerly regional manager for GE Communication Products Department at Columbus, Ohio, he will have regional headquarters at 3200 Maple Avenue, Dallas, Texas. Reed succeeds N. F. Harmon, former GE southwestern regional manager, who accepted a teaching position with the University of Arkansas.

Harry M. Lawson was appointed manager, marketing, for the Medium Steam Turbine, Generator and Gear Department at Lynn, Massachusetts.

Barrett Division, Allied Chemical & Dye Corporation: V. C. Otley, who is a 30-year employee, was appointed director of sales, Industrial Tar Products and Paving Materials.



dropping an eye down a 6" pipe

to probe drillings and casings in oil fields is a job for GPL closed-circuit TV. Consolidated Edison looks for cracks and leaks in natural gas pipe lines.

How many jobs could GPL Industrial TV help you do better?

You'll never know until you investigate! You'll be amazed at the versatility, simple operation, and low cost of Industrial TV systems by GPL, one of the world's leading manufacturers of industrial, military and broadcast TV.

Write us today for free, illustrated brochure on GPL—the most complete line in the industry.

GPL | GPE

GENERAL PRECISION LABORATORY INC.
PLEASANTVILLE, NEW YORK

STITT Sour Gas SPARK PLUGS

LAST 10 TIMES LONGER

Stitt "X" Type Sour Gas plugs resist corrosive action of sour gas — last months longer — require fewer changes — cut "down" time. It's not the plug price, but the "change cost" that's important! Stitts cost a little more — save hundreds of dollars per engine per year. Factory equipment in Clark, Cooper-Bessemer, Worthington, other leading engines.

Write for Field Test Reports
Free $1 Gap Gauge

STITT Ignition Company
Columbus 1, Ohio

Get STITTS From:

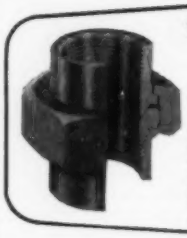
BELL ENGINE SERVICE	JNO. MULLER CO.
BETHLEHEM SUPPLY CO.	REAGAN EQUIPMENT CO.
CLARK BROS. CO.	WAUKESHA ENGINE & EQPT. CO.
COOPER-BESSEMER CORP.	WAUKESHA-PACIFIC
HOPEMAN EQUIPMENT CO.	WAUKESHA SALES & SERVICE Inc.
INGERSOLL-RAND CO.	WORTHINGTON CORP.

MAGNETO IGNITION SERVICE R. ANGUS (ALBERTA) Ltd. CAN.
and Supply Stores Everywhere.

Catawissa PERFECT SEAL Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!



Standard & Double Extra Heavy UNIONS

Available with screwed or socket weld ends. 3000-lb. sizes 1/8" to 3"; 6000-lb. sizes 1/8" to 2".

ORIFICE UNIONS

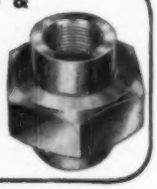
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS

With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

FULL STAINLESS & FULL ALLOY STEEL UNIONS

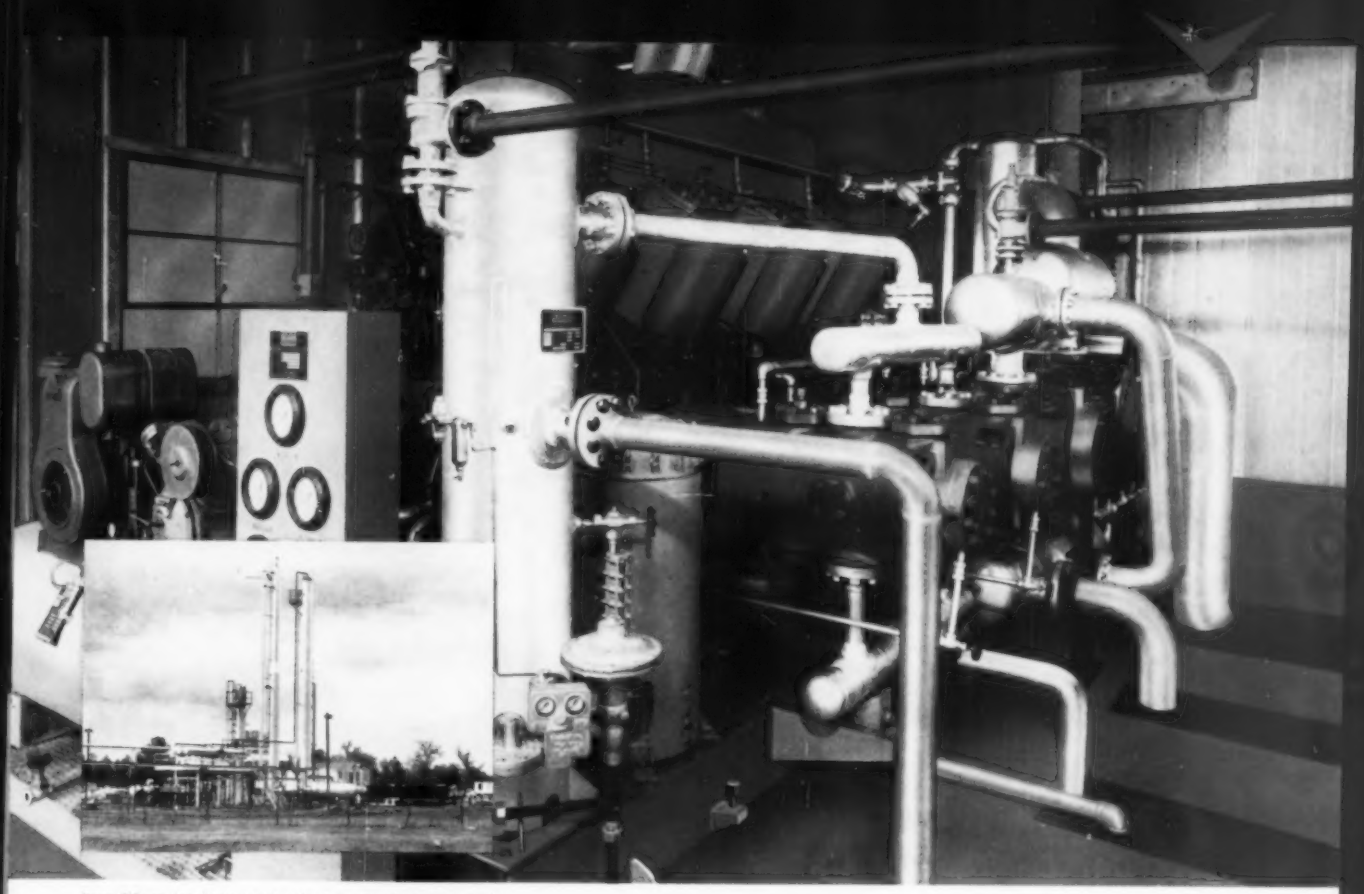
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.



WRITE FOR CATALOG 56
showing the complete Catawissa line of Perfect Seal Products

CATAWISSA VALVE AND FITTINGS COMPANY
60 Mill Street • CATAWISSA, PA.

BEAIRD-INGERSOLL-RAND Packaged Compressor Plant



Jones-O'Brien, Inc. North Keatchie Gas Separation facility equipped with a Beaird-Ingersoll-Rand 440 h.p. 8SVG packaged compressor. Unit has radiator with lubricating oil cooler and updraft air turning duct. Semi-automatic operation has been achieved by equipping unit with speed and pressure regulators and shutdown devices. Other sizes from 120 to 660 h.p.

Gas Separation Facility Uses

DUAL PURPOSE PACKAGED COMPRESSORS

BEAIRD
another AMF product
PACKAGED COMPRESSOR PLANTS

LOWEST COST PER HORSEPOWER INSTALLED

Jones-O'Brien, Inc. has redesigned its North and South Keatchie gas separation facility to increase efficiency and convert to profits 2,200,000 cubic feet of gas being flared daily.

Both facilities have now been equipped with Beaird-Ingersoll-Rand packaged compressors. At the north facility an 8SVG 440 h.p. unit has been set up to perform a dual task. Two cylinders are compressing propane used as a refrigerant in the extraction process and two cylinders are boosting low pressure gas up to sales line pressure. The unit is set to supply 2.68 mmcfd of 200 psi propane from an input of 10 psi. The other two cylinders will boost 1.1 mmcfd of natural gas from 200 psi to 1,150 psi.

A 330 h.p. Beaird compressor at the South facility is boosting 1.2 mmcfd of natural gas to the sales line. Both units have been designed for semi-automatic operation. Engines are equipped with speed and pressure regulators that permit them to speed up and slow down to maintain a constant suction pressure. Other controls and shutdown devices protect the units from unforeseen changes in operating conditions.

Let us show you how Beaird Packaged Compressor plants will fit into your plant modernizing program.

THE J. B. BEAIRD COMPANY, INC.
Shreveport, Louisiana

A Subsidiary of American Machine & Foundry Company

SHREVEPORT, LOUISIANA. *Sales Offices: Dallas, Houston, Corpus Christi and Midland, Texas • New Orleans, Louisiana • Tulsa, Oklahoma • Denver, Colorado Los Angeles, California • Caracas, Venezuela • Cie. Ingersoll-Rand, Paris, France.*

The Most Advanced Power Package You Can Buy...

MERCEDES-BENZ
DIESEL ENGINES

When it comes to filling the power requirements for the Petroleum industry — whether it be for pumping, drilling, electrical generating or other specialized applications — the Mercedes-Benz is ready to provide you with quick, dependable power at the flick of your finger. Unusually long engine life and continuous operation under extreme climatic conditions are made possible by their exclusive, ultra-modern design. Indeed, the Mercedes-Benz is the most advanced power package available today!

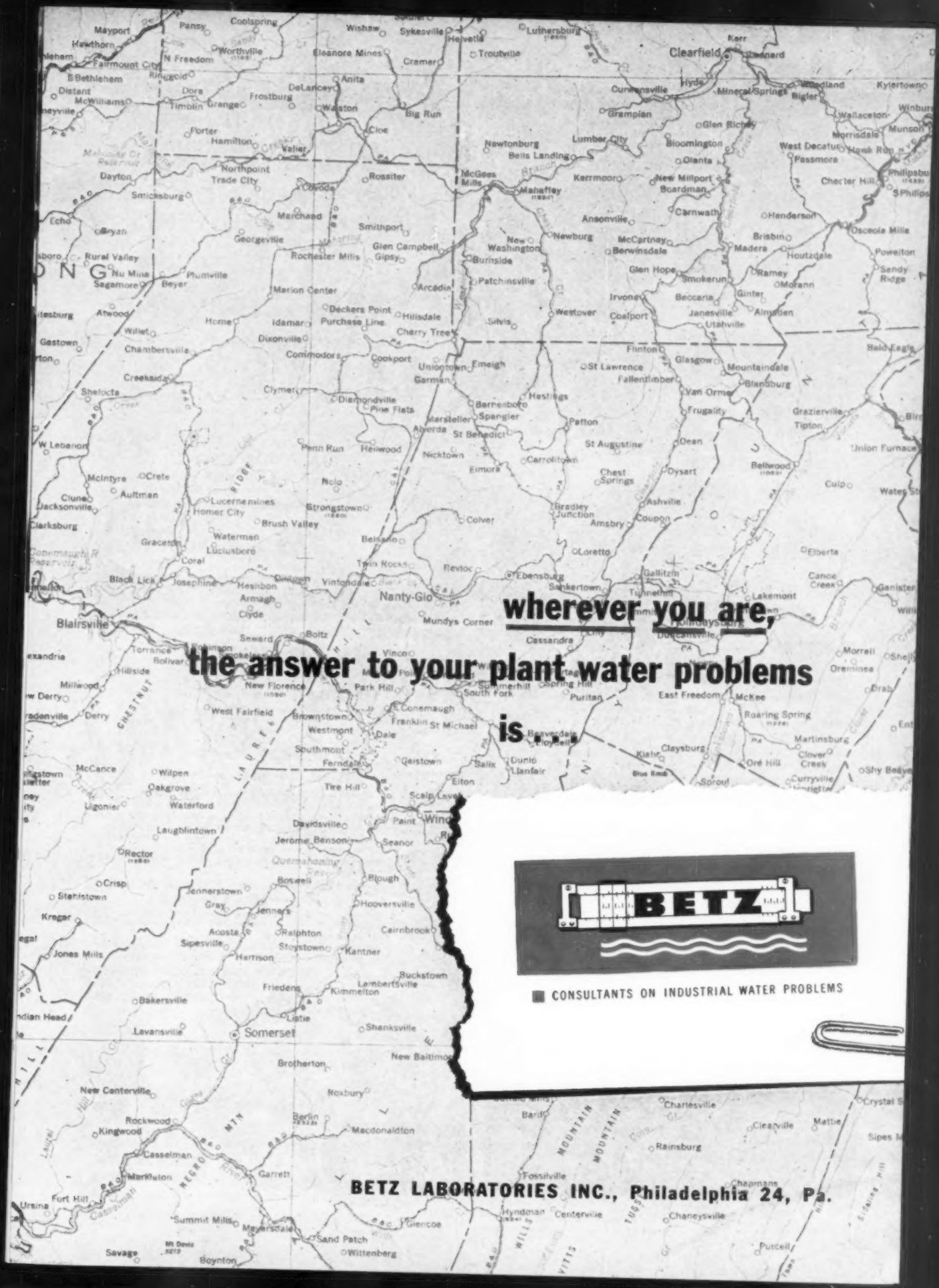
MODEL MB 837 Aa
565 h.p. at 2200 r.p.m.

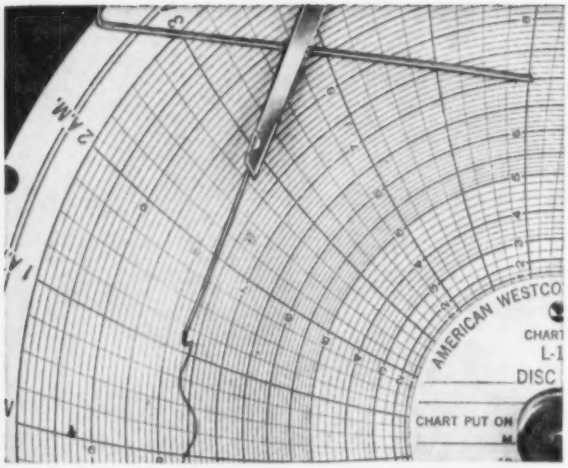
Other Mercedes-Benz diesels available in 12 and 20 cylinders, Turbo and Supercharged, up to 3000 h.p.

UTICA DIVISION

CURTISS-WRIGHT

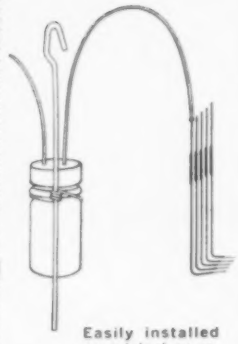
CORPORATION • UTICA, MICHIGAN


wherever you are,
the answer to your plant water problems
is
BETZ
CONSULTANTS ON INDUSTRIAL WATER PROBLEMS
BETZ LABORATORIES INC., Philadelphia 24, Pa.



CANNON PENS

assure legible charts ...eliminate inking problems



Easily installed as original or replacement equipment in all standard recording instruments. Available in five sizes and angles—special pens upon request.

Cannon controlled-flow capillary meter pens provide exceptional dependability and long life with minimum maintenance. Easy to install, these precision pens produce accurate chart records of maximum legibility and continuously record up to a full year without refilling reservoir.

- **Ends Unrecorded Intervals.** Unaffected by pulsating flows, chart speeds, rapid pen movement.
- **Sealed Ink Supply.** Prevents clogging from atmospheric contamination.
- **Two-Way Ink Flow.** Stainless steel writing point is positioned above ink level in reservoir and ink flows in either direction by capillary action—eliminates smearing, blurring.
- **Special Pens.** Designed and produced to customer specifications where special inking problems make standard pens impractical.

Write today for information

AMERICAN METER COMPANY
INCORPORATED (ESTABLISHED 1836)

GENERAL SALES OFFICE: Philadelphia 16, Penna. • Albany • Alhambra • Atlanta • Baltimore • Birmingham • Boston • Chicago • Dallas • Denver • Erie • Houston • Kansas City • Los Angeles • Minneapolis • New York • Omaha • Pittsburgh • San Francisco • Seattle • Tulsa • Wynnewood. IN CANADA: Canadian Meter Company, Ltd., Milton, Ontario • Calgary • Edmonton • Regina

SUPPLIERS TO THE GAS INDUSTRY for Ironcase, Tinned Steelcase, Aluminumcase and Welded Steelcase Meters • American-Westcott Orifice Meters Instruments • Reliance Regulators • Apparatus • Valves

APPROVED BY REFINERS

CONTAINS NO CHLORINATED SOLVENTS
OR OTHER HALIDES OR SULPHIDES

BrakeSol

The most effective chemical for treating

PARAFFIN

Control paraffin in tubing, flow lines and tanks by the CONSTANT injection of BRAKESOL. This eliminates costly Paraffin removal methods. Reclaim tank bottoms with BRAKESOL.

FOR SERVICE
Contact your Supply Store or nearby Treating Engineer.

BrakeSol INC.

P. O. BOX 9506 • OKLAHOMA CITY, OKLA.
EXPORT DISTRIBUTOR: THE NATIONAL SUPPLY CO., EXPORT DIVISION

The Essence of
CALIFORNIA
Living is here

In beautiful "LA JOLLA-by-the-Sea"

. . . the jewel of the sun-drenched southland. Weather-perfect the year around in a setting of unsurpassed scenic beauty.

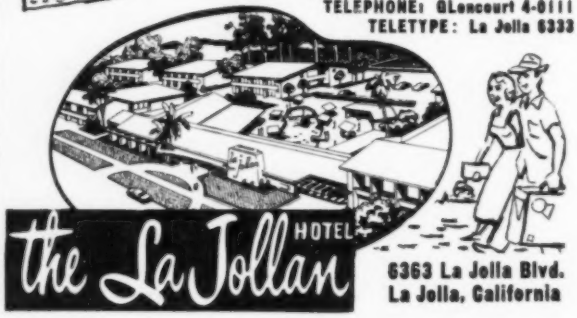
The new La Jollan—finest in casual, carefree living. 350 beautiful rooms with majestic view of the Blue Pacific or picturesque mountains—29 buildings in garden setting. Temperature controlled swimming pool, convenient beach. Children's supervised play area. Golfing, tennis, boating, surfing, fishing. Excellent shops nearby.

3 Beautiful Dining Rooms and Cocktail Lounges Dancing Under the Stars

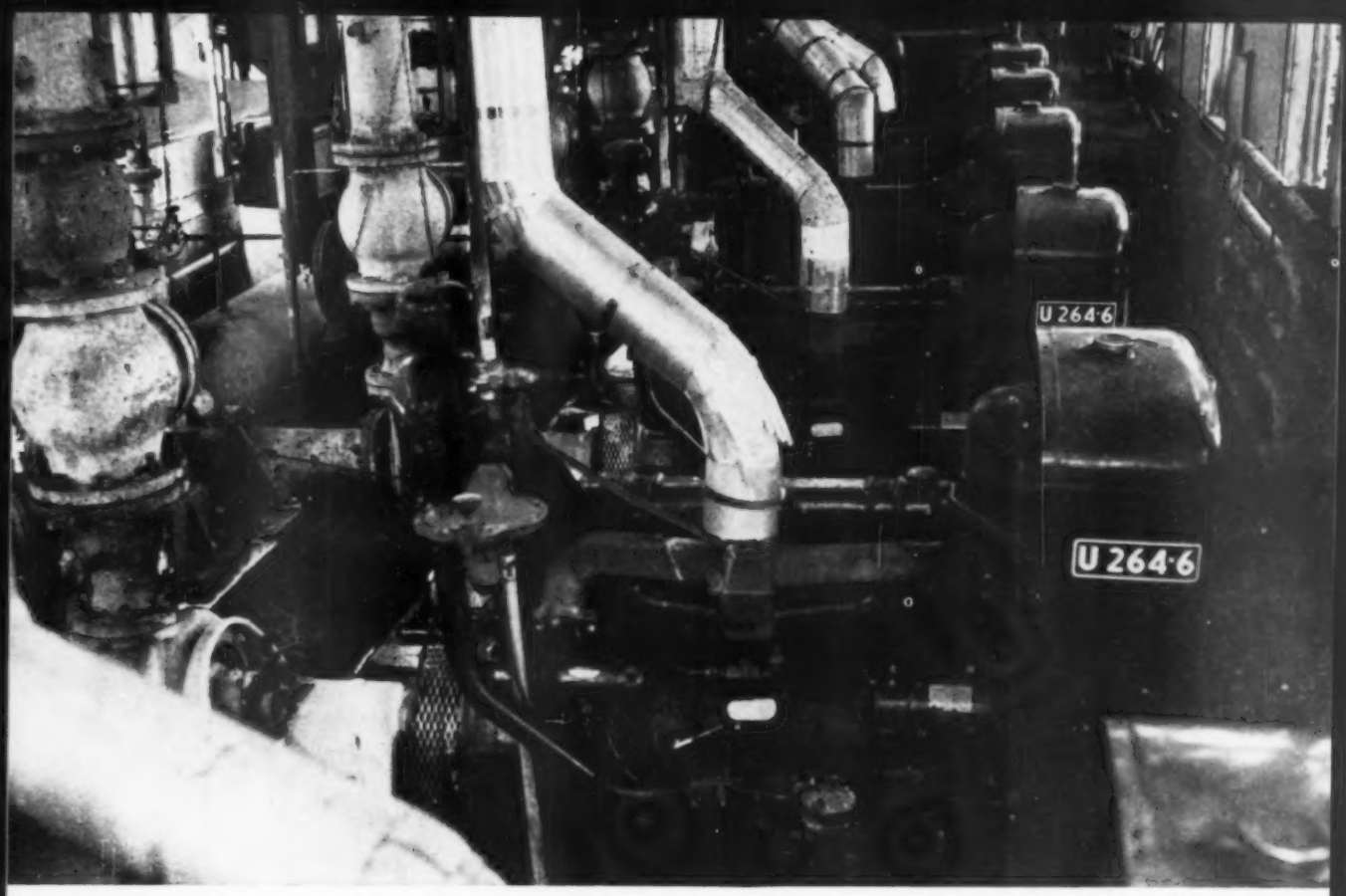
Luxurious, ultra-modern accommodations—guest rooms, and studio suites with or without kitchens—all with private sun deck, deluxe television and radio.

For a day, month or season reservation—write, wire or telephone Complimentary transportation to and from train or plane.

WRITE FOR BEAUTIFUL COLOR BROCHURE
TELEPHONE: GLencourt 4-0111
TELETYPE: La Jolla 6333



the La Jollan HOTEL
6363 La Jolla Blvd.
La Jolla, California



Circulating cooling tower water round-the-clock in Union Oil's refinery at Cutbank, Mont., is the job of these six International U-264-6 power units. These engines have 264 cu. in. piston displ. and produce up to 54 continuous-load hp on natural gas.

Six heavy-duty Internationals replace short-lived auto engines at Union Oil

Company puts rugged natural gas U-264-6's on refinery pumps after lightweight, high-speed engines last only 2 years

The Union Oil Co. discovered a simple way to reduce pump power costs substantially in the firm's Cutbank, Mont., refinery. High-speed, short-lived automotive engines were replaced with heavy-duty International U-264-6 six-cylinder industrial engines.

Maintenance costs proved the lightweight auto engines didn't measure up to Union's power need—pumping cooling tower water. Engines usually wore out in two years' time. So Union switched to International U-264-6's and a full measure of low-cost dependable hp.

You can get the same long-life, low-maintenance performance from any of six compact International 6-cylinder carbureted oil field engines. Here's why: flexible economical power with fuel saving combustion chambers; efficient valve-in-head design; smooth power with counterbalanced crankshaft and heavy flywheel; full-pressure lubrication for minimum maintenance; your choice of carburetion—gasoline, LPG, or natural gas; rugged attachments that fit the IH engine to your job.

See your nearby International Power Unit Distributor or Dealer before you buy. He sells 21 carbureted and diesel engines ranging from 16.5 to 265 hp and he backs what he sells with very special service when you need it.

International® *Construction Equipment*

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

A 7500-foot Tiger Brand line was used on this rig and was cut back 69 feet each time to get maximum service from the rope.

gets heap big run

of 120,000 ton-miles from one 7500-foot Tiger Brand Wire Rope

Joe Blackman, American Wire Rope Specialist, and E. J. Stufflebeam, tool pusher, check a piece of wire rope for wear after the 120,000 ton-mile run.

Drilling was tough in this area and vibration severe, but the Tiger Brand lines withstood it without trouble.

This is the best ton-mile record made in the Eola Field according to Mr. E. J. Stufflebeam, tool pusher on the Big Chief Drilling Company's Rig No. 29 in Garvin County, Oklahoma. He goes on to say, "I've run experiments on various lines, including high strength, but we've got better runs from Tiger Brand than any other ropes we ever used. One reason is that American Steel & Wire sends a field man around who checks what is happening and offers good suggestions on how to improve wire rope life."

The wire rope used on this rig was American Tiger Brand, 1¼-inch, 6x19 Monitor Excellay with wire core . . . the best drilling line you can buy. Write for complete information.

AMERICAN STEEL & WIRE
DIVISION
UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS AMERICAN TIGER BRAND WIRE ROPE

Excellay Preformed

MAIL THIS COUPON

American Steel & Wire
Room 6E-28, Rockefeller Building
Cleveland 13, Ohio

☐ Rush me one free Tiger Brand Ton-Mile Calculator.

☐ Have your representative call to show me how this calculator can help me cut line costs.

Name .....

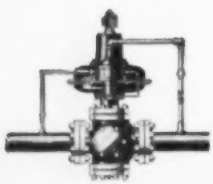
Firm .....

Address .....

City & State .....

UNITED STATES STEEL

WHAT...a "super market" in this business?

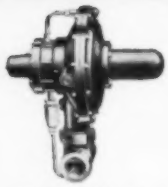


Type 657 with 3500 Positioner

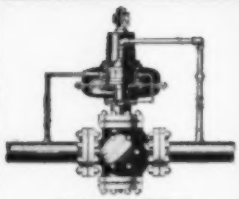
Type 4150 and 4160 Wizard II Pressure Controllers

Type 95 Pressure Reducing Valve

Type 630 "Big Joe" Field Regulator



Series 99 Multi-Purpose Gas Regulator

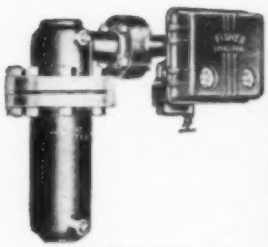


Series 298T Gas Regulators

Type 655-A Pressure Regulator

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

YES! *now you can shop by phone, wire or TWX...* for shipment within 36 hours!

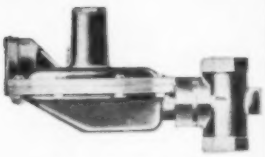


Series 2500-249 and 259B Level-Trols
Cage Sizes 14" and 32"

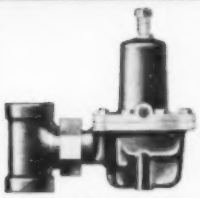
FACTORY STOCK ALWAYS ON HAND:

- Large stock of BORDER & DISTRICT REGULATORS
- Wide choice of GAS REGULATORS
- Assorted types of MULTI-PURPOSE REGULATORS

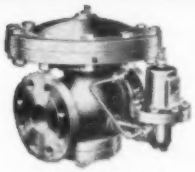
Type 75 Water Reducing Valve



Series S100 and 730 Service Regulators



Series 620 and 621 Farm Tap Regulators



Type 92B Pilot Operated Steam Reducing Valve

Series 67FR Combination Filter Regulator

Fisher's new special service department is organized much like a super market to help you meet emergency requirements with dispatch and speed.

A stock of the popular and standard diaphragm control valves, Wizard Controllers, level-trols and all types of gas regulators are kept on the shelf at all times ready to go.

Every Fisher representative receives a weekly list of all available types for the following week.

Now, when you're up against an emergency, phone, wire or TWX (Marshalltown 578 or 579) the factory or your Fisher representative ... your order will be enroute within 36 hours (except Saturday and Sunday) after it is received in Marshalltown.

FISHER® Controls
SINCE 1880

FISHER GOVERNOR COMPANY
Marshalltown, Iowa/Woodstock, Ontario/London, England

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

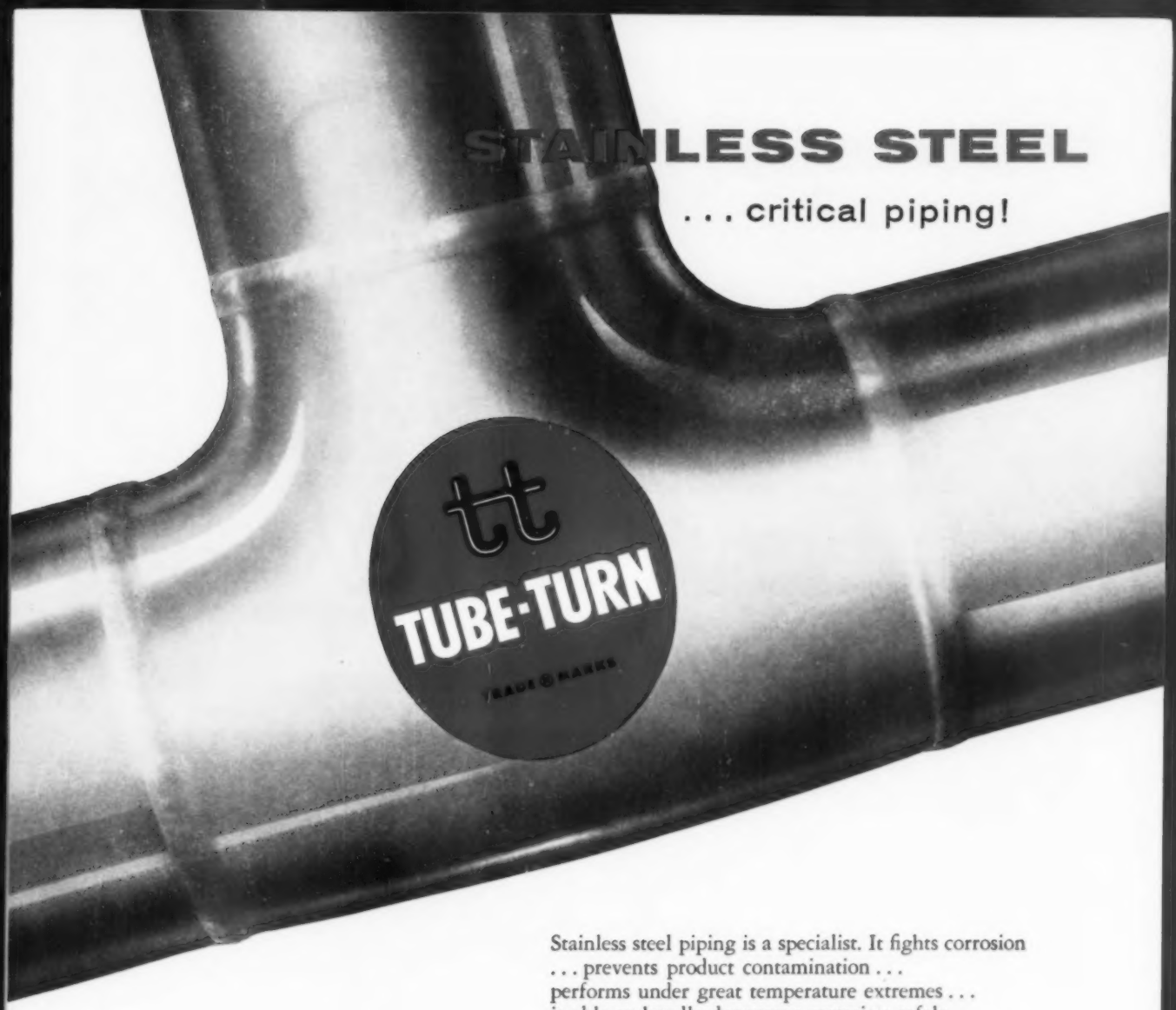
"We feel a responsibility to participate in the development of friendly foreign nations. Our participation is a practical and efficient supplement to our government's foreign aid program; we help to create understanding and respect for American ways and customs in foreign lands. And we believe that expanding international trade is of vital interest to our country's welfare and to world peace."

Eugene Holman, Chairman of the Board, Standard Oil Company (New Jersey)

Esso

STANDARD OIL COMPANY (NEW JERSEY)
AND AFFILIATED COMPANIES

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



. . . a critical place to safeguard your reputation with "**TUBE-TURN**" products

Stainless steel piping is a specialist. It fights corrosion . . . prevents product contamination . . . performs under great temperature extremes . . . is able to handle dangerous materials safely. Construction and maintenance dollars, often the safety of life and property, and *your reputation* are at stake in the selection of these materials.

When you specify TUBE-TURN* Stainless Steel Fittings and Flanges, you get extra-value features and greater strength at no extra cost. Fittings are marked with *complete* identification. Production procedures and quality control assure conformity to all code requirements.

Your nearby Tube Turns' Distributor can meet *all* your needs in welding fittings and flanges *promptly*.

*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

TUBE TURNS LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Detroit • Atlanta • New Orleans • Houston • Midland
Dallas • Tulsa • Kansas City • Denver • Los Angeles • San Francisco • Seattle

In Canada: Tube Turns of Canada, Ltd., Ridgetown, Ontario • Toronto, Ontario • Edmonton, Alberta • Montreal, Quebec • Vancouver, B.C.

YOUR SAFEGUARDS

You get these extra values

at no extra cost with

TUBE-TURN

Stainless Steel Fittings

- Fittings meet *all* standard chemistry specifications
- Minimum wall thickness of elbows are at least 87½% of nominal
- All fittings meet calculated bursting pressure of matching pipe
- Qualified welders and procedures used where welding is required
- Each fitting properly solution heat-treated
- Each fitting passivated
- Special grades of stainless steel, and all other alloys available

Meet all codes: ASTM A403 (for material and manufacturing procedure); MSS SP43 and ASA B16.9 (for dimensions); and MSS SP25 (marking procedure).

TUBE-TURN Stainless Steel Elbows and Tee in a petrochemical plant.

UNIFORM WALL. Fittings meet ASA standards of 87½% of nominal thickness . . . particularly important for light wall elbows. Many conventional stainless steel elbows are as much as 30% to 40% below nominal at this point of greatest wear. All TUBE-TURN® Stainless Steel Fittings, including tees, match calculated bursting strength of the pipe.

COMPLETE IDENTIFICATION. You *know* this fitting conforms to specified quality because the material type and quality control are fully identified. Manufacturer, size, wall thickness and schedule are also marked as shown on the fitting.

CUTS PURCHASING COSTS. You can order TUBE-TURN Stainless Steel Fittings from your nearby Tube Turns' Distributor . . . on the same order as other types of welding fittings in Tube Turns' line of 12,000 products. Cuts red tape. Saves time. Photo courtesy McJunkin Corporation, Charleston, W. Va.

STAINLESS STEEL CATALOG—Complete information on properties, application, standards, welding procedure and all types of **TUBE-TURN** Stainless Steel Fittings and Flanges. Mail coupon for your free copy.

TUBE TURNS, Dept. K-1
224 East Broadway, Louisville 1, Kentucky
Please send STAINLESS STEEL CATALOG.

Company Name_____

Company Address_____

City_____ Zone_____ State_____

Your Name_____

Position_____

Available from your nearby TUBE TURNS' Distributor

®"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

TUBE TURNS

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Detroit • Atlanta • New Orleans • Houston • Midland • Dallas • Tulsa • Kansas City • Denver • Los Angeles • San Francisco • Seattle. **IN CANADA:** Tube Turns of Canada Ltd., Ridgetown, Ontario • Toronto, Ontario • Edmonton, Alberta • Montreal, Quebec • Vancouver, British Columbia.

GUARDING 5 BILLION FLIGHT MILES

"On final approach," radios the pilot. Down goes the landing gear for another happy landing. Special petroleum lubricants and fuels – pioneered by Texaco research – play an important part in the 5 billion passenger miles flown each year. *During the past 22 years more scheduled revenue airline miles in the United States have been flown with Texaco Aircraft Engine Oil than with all other brands combined.* A typical example of how Texaco research cooperates with industry.

TEXACO

THE TEXAS COMPANY

Progress . . . at your service

STATEMENT OF CONDITION

At the Close of Business December 31, 1957

ASSETS

Cash on Hand and Due from Banks		$296,794,262.89
United States Government Obligations	$82,597,115.85	
Public Housing Authority Obligations (Fully Guaranteed)	4,440,747.06	
State, County, and Municipal Bonds	16,658,593.57	103,696,456.48
Other Bonds		6,144,308.51
Stock in Federal Reserve Bank		1,533,000.00
Loans and Discounts		378,433,617.73
Commodity Loans		8,359,897.95
Income Accrued		2,466,162.65
Letters of Credit and Acceptances		13,984,471.59
Banking House and Equipment		9,469,968.16
Other Assets		121,543.87
		$821,003,689.83

LIABILITIES

Capital Stock	$ 23,100,000.00	
Surplus Fund	28,000,000.00	
Undivided Profits	5,002,438.96	$ 56,102,438.96
Reserved for Contingencies		7,973,350.28
Reserved for Taxes, Etc.		5,987,908.24
Deferred Income		2,274,183.70
Letters of Credit and Acceptances		13,984,471.59
DEPOSITS:		
Individual	$484,626,192.16	
Banks	237,951,720.49	
U. S. Government	12,103,424.41	734,681,337.06
		$821,003,689.83

DIRECTORS AND ADVISORY DIRECTORS

CLAUDE O. ADAMS*
Vice President, Braniff International Airways

NATHAN ADAMS*
Honorary Chairman of the Board

JOE AGEE*
Senior Vice President

GEORGE N. ALDREDGE*
Chairman, Loan Committee

H. W. BASS
Chairman of the Board, Harry Bass Drilling Co.

HENRY C. COKE, JR.
Coke & Coke, Attorneys

ROSSER J. COKE
Coke & Coke, Attorneys

CARR P. COLLINS
Chairman of the Board Fidelity Union Life Insurance Co.

J. B. DONOVAN*
President, Donovan Manufacturing Co.

EARL FAIN*
Investments

EDGAR L. FLIPPEN*
Investments

HANS C. GLITSCH
President, Fritz W. Glitsch & Sons, Inc.

R. A. GOODSON
Vice President and General Manager, Southwestern Bell Telephone Co., Texas Area

W. A. GREEN, JR.*
Investments

S. J. HAY
President, Great National Life Insurance Co.

JOHN T. HIGGINBOTHAM
Chairman of the Board, Higginbotham-Bailey Co.

JOSEPH L. HIGGINBOTHAM*
Vice President, Higginbotham-Bartlett Co.

ROY W. HILL*
President, Radio City Distributing Co.

ERNEST HUNDAHL*
Manager, Southwest Division, United Benefit Life Insurance Company and Mutual Benefit Health and Accident Association

T. E. JACKSON
Southwestern Manager Pittsburgh Plate Glass Co.

JOHN J. KETTLE
Senior Vice President

LOUIE KIMPLE*
President, Dixie Wax Paper Co.

ERNEST L. KURTH*
President, Southland Paper Mills, Lufkin, Texas

WALTER W. LECHNER*
Oil Production

EUGENE McELVANEY
Senior Vice President

ROBERT E. McKEE, JR.
Vice President, Robert E. McKee General Contractor, Inc.

C. A. MANGOLD, JR.*
President, American Laundry Co.

BLAGDEN MANNING
Chairman, Executive Committee

A. D. MARTIN
President, Central Engineering and Supply Co.

HARRY S. MOSS
Independent Oil Operator

WILLIAM F. NEALE
President William F. Neale & Co.

J. S. O'HARA
Chairman of the Board, Dr. Pepper Co.

HYMAN PEARLSTONE
President, Higginbotham-Pearlstone Hardware Co.

O. U. PICKERING*
President, Vitalic Battery Co., Inc.

H. NEVILLE PIERCE*
President, Southern Fertilizer & Chemical Co.

W. L. PRENN*
Consultant, Brazilian Telephone Co., Rio de Janeiro, Brazil

HUGO W. SCHOELLKOPF*
Chairman of the Board, The Schoellkopf Co.

J. FRED SCHOELLKOPF, JR.
Investments

E. E. SHELTON
President, Dallas Federal Savings & Loan Association

ARTHUR STAR*
Investments

R. H. STEWART, JR.
Investments

J. C. TENISON*
Investments

ROGER L. TINNANT
Investments

ARCH S. UNDERWOOD*
President, Union Compress & Warehouse Co., Lubbock, Texas

JACK C. VAUGHN*
Oil Producer and Co-Owner, Spartan Drilling Co.

TRAVIS T. WALLACE*
President, Great American Reserve Insurance Co.

ROBERT F. WEICHSEL*
Vice President and Treasurer Great National Life Insurance Co.

JAMES RALPH WOOD
President, Southwestern Life Insurance Co.

BEN H. WOOTEN
President

TODDIE LEE WYNNE
President, American Liberty Oil Co.

*Advisory Directors

The Major Difference Between Banks of Today is the Way People are Treated.

Ben Wooten
PRESIDENT
First National Bank in Dallas

GIVE US AN OPPORTUNITY TO SAY "YES"

1st

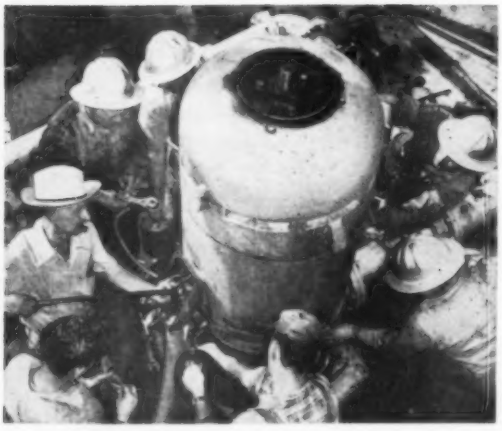
82 years of growth through service to people

NATIONAL BANK in Dallas

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Where service begins-LAYNE



A telephone call brings action—for the service facilities, know-how and experienced work crews of your nearby Layne Associate Company.

Layne service is based upon undivided responsibility throughout every phase of every water development job, from initial surveys and construction, to operation and maintenance.

For service before, during and after well construction, look to Layne and your nearby Layne Associate Company, a member of the community it serves.

Completely equipped work crews handle water well and pump servicing — backed by over 75 years of field experience.

LAYNE & BOWLER, INC. MEMPHIS
General Office and Factory — Memphis 8, Tenn.
Layne Associate Companies throughout the world.

Water Wells • Vertical Turbine Pumps • Water Treatment

LAYNE & BOWLER, INC.
Memphis 8, Tennessee

Gentlemen:

Please send me Bulletin No. 100

Name _____

Title _____

Organization _____

_____

Address _____

City _____ *State* _____

CATERPILLAR

PIPELINER WINS THE BATTLE OF THE MOJAVE DESERT

Unexpected rock. High winds. Rivers. Mountains. Sand. R. H. Fulton overcame them all with the help of its Caterpillar spread.

NEW CATERPILLAR NO. 572 PIPELAYER, left, teams up with No. 583 and the MDW8, lowering in on the Mojave Desert. The new No. 572 has a capacity of 86,000 pounds with a 19-inch ground clearance and 86-inch track gauge to give stability.

D9 WITH KELLY RIPPER (left) prerips unexpected rocky soil for ditcher. The Cleveland Ditcher (right) which follows is powered by a dependable Cat D339 Engine. The ditcher is cutting a depth of 65 inches at about 28 feet per minute.

NATURE put R. H. Fulton & Co. to the test during a 241-mile natural gas pipeline job across the Mojave Desert from Needles to Newhall, Calif.

Rock cropped up unexpectedly. Unseasonable high winds held up welding and painting, at times backfilled the ditch. Sand made maintenance of a firm ditch difficult. There were three river crossings and rugged mountainous terrain. But Fulton, with the help of its big Caterpillar spreads, overcame each obstacle, lowering in an average of 5,000 to 6,000 feet a day with a one-day high of 16,000 feet.

The 30-inch line is part of a $33.5 million joint expansion program of Southern California and Southern Counties Gas Companies. It will provide an additional 227.6 million cubic feet of gas per day.

Here are some of the problems Fulton encountered and how they were overcome:

ROCK—This occurred in stretches of presumably sandy material from 9 to 24 inches below the surface. By using huge Kelly Rippers mounted on the giants of the spread—CAT* D9 Tractors—a great deal of shooting was eliminated. The D9-Kelly Ripper combination preripped the rocky soil for the ditcher.

Because of danger of rock damage to pipe in backfilling, the entire length is padded on the bottom of the ditch and top of the pipe. Two Cat No. 977 Traxcavators* and a Crosse Ditch Padder side-mounted on a D8 were used for the padding operation. A D7, working with a No. 12 Motor Grader, backfilled.

WIND—Unseasonable high winds backfilled the ditch and periodically stopped welding and painting operation. But welding crews set a brisk pace in spite of the winds. Using Caterpillar* Twin Arc-Welders on Athey track wagons pulled by a D7, their best day was 16,200 feet.

MOUNTAINOUS TERRAIN—Rugged Kane Springs Canyon and the Ord Mountains had to be crossed. A D8 and D9 were used to winch a Northwest Backhoe over the steep canyon grade. Later, D9s towed stringing trucks in and out of the mountainous area.

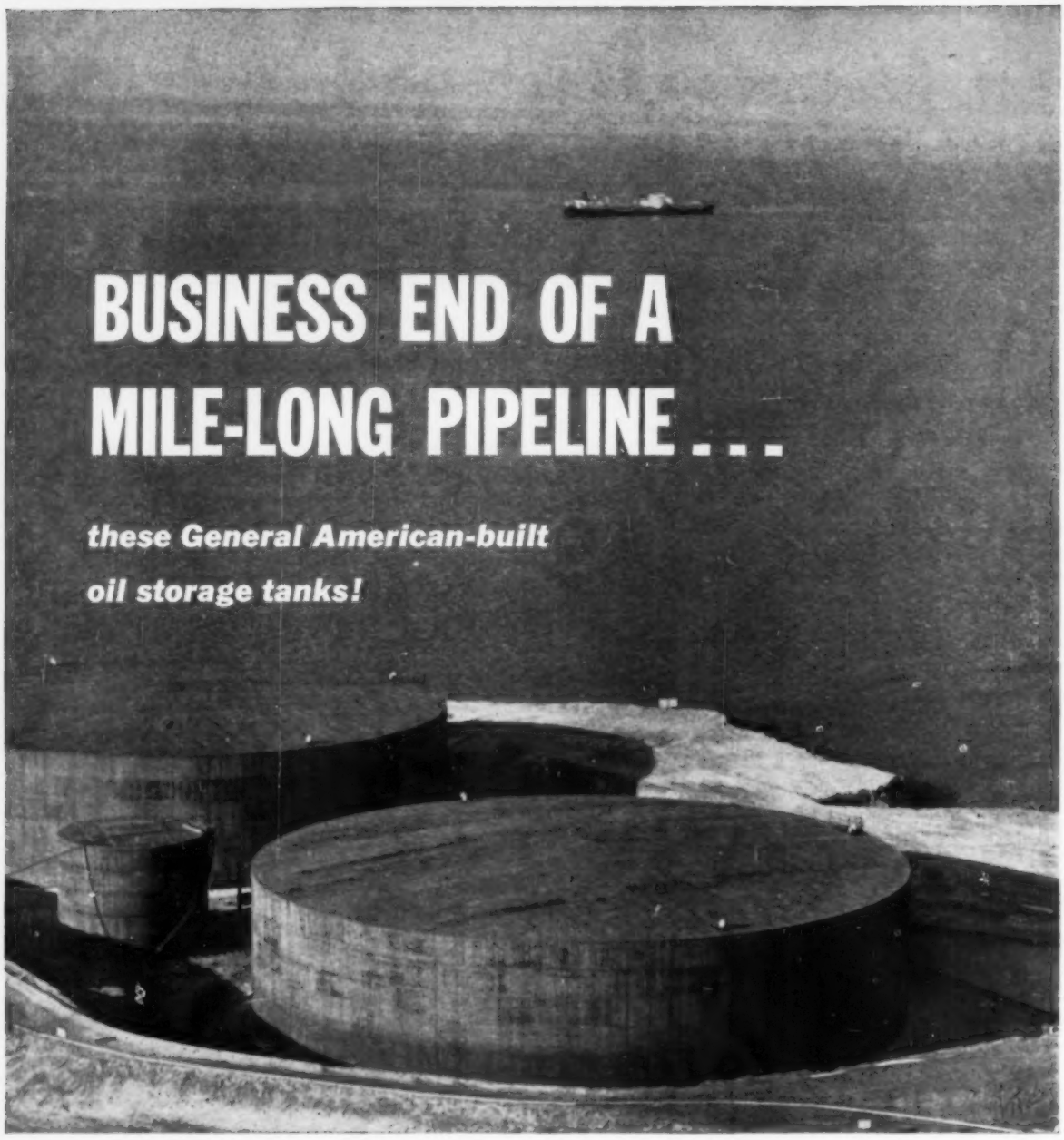
Altogether, Fulton had almost 70 Caterpillar track-type Tractors and Pipelayers at work. In addition there were five Twin Arc-Welders, and dependable Caterpillar Diesel Engines powered cranes, backhoes and ditchers.

When it comes to the tough jobs, pipeliners know there is only one make of equipment designed to produce wherever the pipe takes them. That's why the standard color in fast-moving spreads throughout the world is Caterpillar yellow.

CAT TWIN ARC-WELDERS, mounted on Athey track wagons and pulled by a D7, helped make up for time lost due to high winds in the desert. Best day: 16,200 feet.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS, U. S. A.

*Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.



Moored more than a mile offshore in 70 feet of water, even the world's largest tankers (or any tanker presently contemplated) can deliver cargoes direct to these twin 268,000-barrel storage tanks . . . eliminate double handling and costly barging charges.

Each 200 feet in diameter, 48 feet in height, the tanks were custom-engineered, erected on the site by General American's Plate and Welding Division for Northville Dock's new Long Island Terminal. New York State's largest tanks . . . they provide storage for 22,500,000 gallons of oil.

If you need expanded storage right now, or as insurance against future demands, look into the facilities offered by General American. Whatever your storage problem—liquid or gaseous—you'll find . . . *it pays to plan with General American.*

PLATE & WELDING DIVISION
GENERAL AMERICAN
TRADE MARK

PLATE AND WELDING DIVISION
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South La Salle Street
Chicago 90, Illinois

STEEL PLATE FABRICATORS ASSOCIATION

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

RESERVOIR ENGINEERS

(Ages 27-38)

A major integrated U. S. Oil company operating in Venezuela has outstanding career opportunities for qualified RESERVOIR ENGINEERS. Excellent growth possibilities are present in an expanding technical organization. Graduate engineers and physicists who have had FIVE to TEN years of specialized and general petroleum reservoir engineering experience are invited to submit a complete resume of work experience and personal data. Naturally, all replies will be held in confidence and interviews arranged for qualified candidates. Salary, including bonus, $14,900-$18,000, depending on qualifications and experience. Company is a leader in the petroleum industry with excellent employee benefits, including home vacations with travel expenses.

Box 480 Department Y-80

New York 19, N. Y.

INFORMATION UNLIMITED — Read MONITOR — easiest, quickest way to keep pace with fast-moving oil industry. Specialists abstract articles from more than 100 petroleum publications of 11 countries. Executives, engineers, geologists, researchers: keep informed on engineering techniques and news in your field — subscribe now to this bi-monthly magazine. Major oil companies approve. One year, $7.50 (foreign $8.00). Request free copy. MONITOR, Box 476-E, Dallas 21, Texas.

"Meet Me at the Manx"

MANX HOTEL

At Union Square

San Francisco's most strategically located hotel — in the heart of the shopping, business, financial, and entertainment districts. 300 efficiently-serviced and well-maintained guest rooms. Rapid garage service from our entrance. Beautiful cocktail lounge.

Sightseeing and Travel Information in Lobby

300 Rooms

Singles from 5.00
Doubles from 6.50
Twins from 7.50

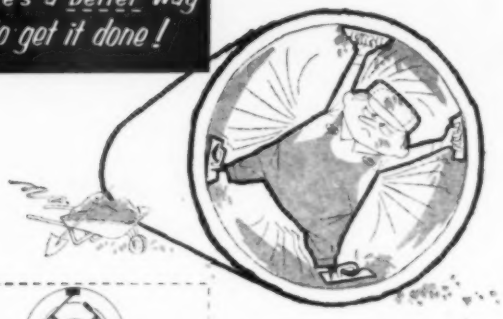
All with bath

225 Powell Street

San Francisco

CALIFORNIA

there's a better way to get it done!



Centrifugally applied and mechanically trowelled

Compact, mobile machine moves through the line

Centriline Process applies smooth, continuous leak-proof lining to inside of 16" to 144" pipe lines "in place." Applicable to fresh or salt water, oil, gas or industrial waste lines. Eliminates interior corrosion and leakage. Restores full flow coefficients.

Write for full information TODAY!

Specializing in Pipe Protection Problems
• Tate and Centriline "In Place" Interior Cement Mortar Lining • "In Plant" and "Railhead" Centrifugal Spinning of Cement Mortar or Coal Tar Linings – Somastic® Exterior Coating • Pipe Wrapping • Reclamation: Removal of Old Wrapping, Straightening, Blasting, Beveling, Testing

PIPE LININGS A Division of American Pipe and Construction Co.

2414 East 223 St. (P. O. Box 457)
Wilmington, California

THE RECTORSEAL® FAMILY

OF THREAD SEALING COMPOUNDS FOR PETROLEUM AND PETROCHEMICALS

Whatever your needs, there's a time-tested Rectorseal compound to provide positive, leakproof thread or gasket connections, more economically. Ask for free sample by number or outline your sealing problem.

RECTORSEAL ① CASING OR TUBING CONNECTIONS
Insoluble in petroleum products—impervious to salt water, dilute acids and corrosive action.

RECTORSEAL ② PETROLEUM RESISTANT
Fast dry—Soft set. For all petroleum gases and liquids, as well as water, refrigerants, air.

RECTORSEAL ③ PETROLEUM RESISTANT
Slow dry—Soft set. For all the same services as Rectorseal 2 above. Especially suited to assembly line work because Rectorseal 3 will not dry out in open container.

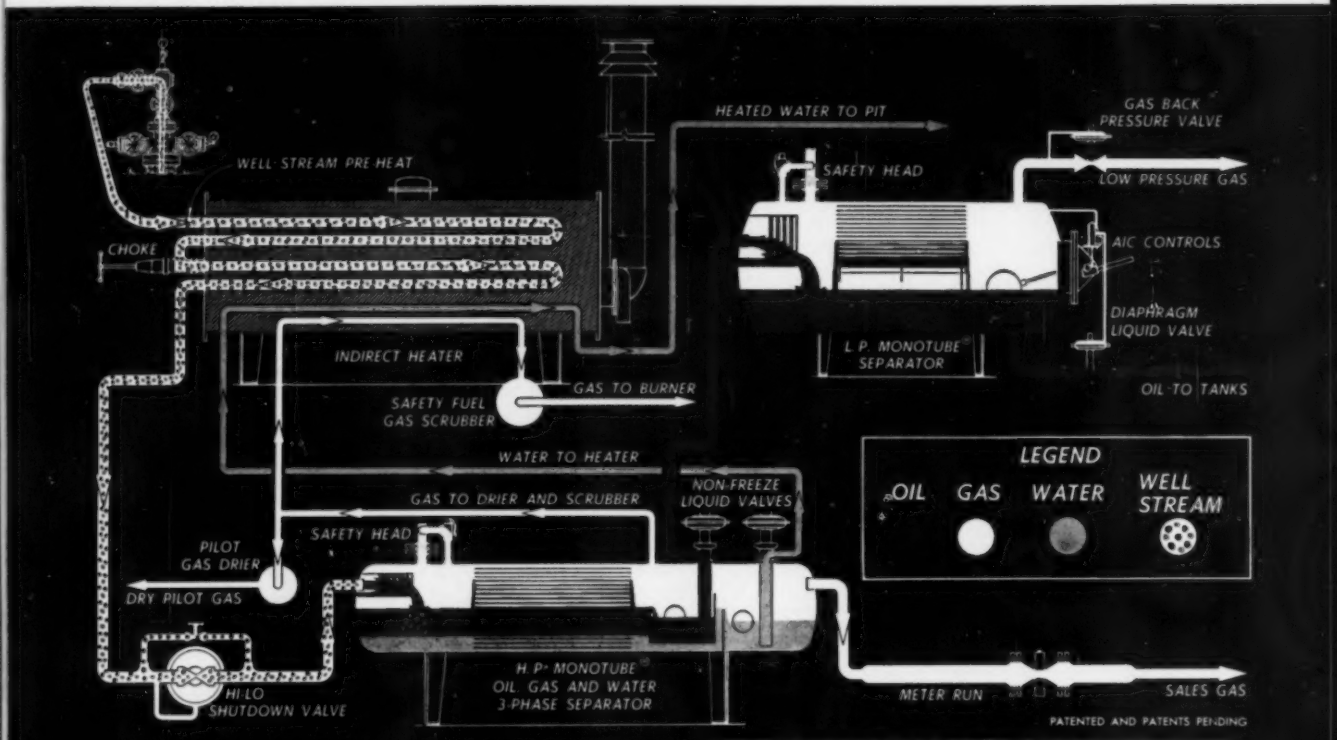
RECTORSEAL ⑦ ALCOHOL RESISTANT
Specifically prepared for holding oxygenated solvents, such as alcohols, acetone, ethylene glycol, as well as water, brine, steam, caustic acid and alkali. Non-setting paste.

RECTORSEAL ⑮ FOR OXYGEN LINES AND FITTINGS
Non-flammable, non-toxic. Prepared in accordance with requirements of military specification MIL-T 5542B (ASG).

Write for free sample of the Rectorseal you need for your service.

RECTORSEAL, DEPT. H
2215 Commerce Houston 2, Texas

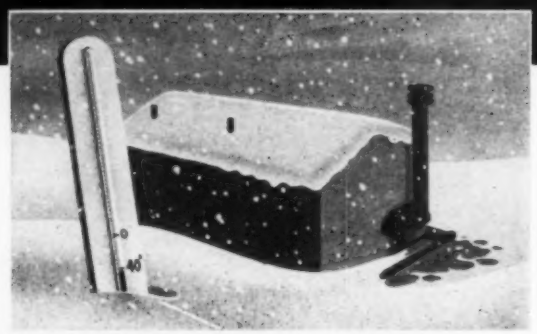
RECTORSEAL®
THE POSITIVE LEAK PREVENTER



Be Prepared for Winter

NATIONAL'S HIGH PRESSURE GAS WELL PRODUCTION UNIT

- A complete shop fabricated packaged unit.
- Portable — skid mounted.
- May be used for well test purposes.
- Minimum field labor required to install.
- Housed in steel and fiberglass insulated for protection against cold, wind, snow, rain, dirt.
- National Tank Company non-freeze valves give added insurance against liquid freezing.
- Outlet water from separator is heated in the indirect heater previous to being dumped to pit.
- All gas expelled from controls and relief connections is vented to the outside of the building to minimize fire hazard.
- Meter run for gas measurement.
- Main stream safety valve with hi-lo shut down pilot will shut down well stream to unit in case of pressure build up and/or down-stream line breakage.
- Solid desiccant type pilot gas drier insures moisture-free instrument gas.



FIELD PROVEN IN -40° CLIMATE

- Safety fuel gas scrubber insures liquid free gas to burner in heater.
- Instrument and burner gas pre-heated in pre-heat coil in indirect heater.
- Main stream from well head is pre-heated ahead of adjustable choke to insure melting of any hydrates upstream of pressure reduction which may occur in line between well head and the unit.
- 3-stage separation advantages.
- Without winterized house, unit ideal for other climates.

Buy National! See your National Tank Company representative in your area, or write — wire — phone National Tank Company, Box 1710, Phone CHerry 2-9141, Tulsa, Oklahoma

Write for Color flow diagram

It's National®

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

THE O·C·T C-20 CASING HEAD

lets you work in *Safety*

Regardless of how or when you decide to install the O-C-T "C-20" Casing Hanger . . . before cementing, after cementing, through preventers, under preventers, or at any time in case of stuck pipe . . . you can improve the safety of your completion operations and save hours of expensive rig time due to the flexible, simplified O-C-T installation procedure.

Let your O-C-T Representative give you all the details or write for complete information. Available through more than 700 supply store locations.

The first quick-setting, positive-sealing well head designed especially to eliminate open hole hazards in medium depth wells, the O-C-T "C-20" Casing Hanger can't forget to seal . . . because the sealing element, slip bowl and slips are assembled as a single unit that may be wrapped quickly around the casing, latched and dropped into place, eliminating the possibility of individual parts being installed incorrectly.

FOR DUAL COMPLETIONS
Specify O·C·T

The compact Oil Center Tool Company Christmas Tree assembly provides a safe, strong and practical means to economical dual completions.

If you are considering dual completions, it will pay you to check the features and get the full story of this O-C-T Dual Completion Assembly.

where progress is a daily practice

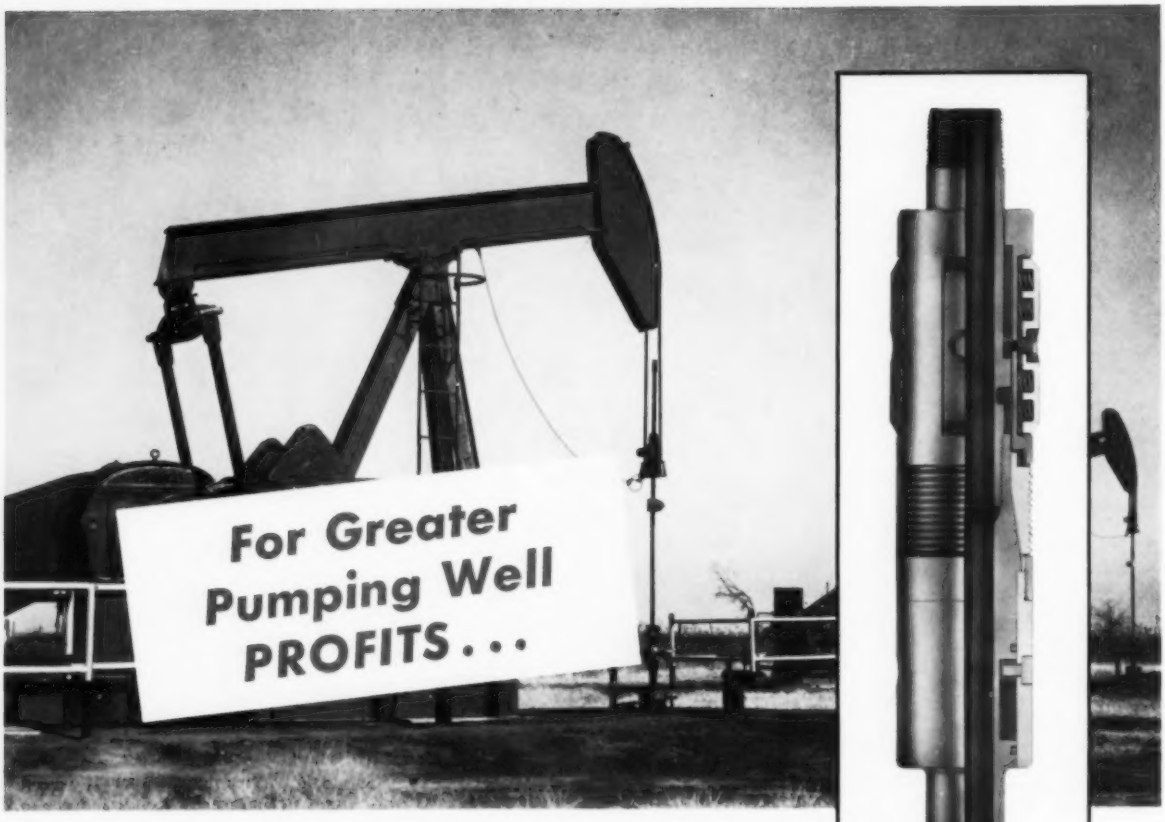
O·C·T

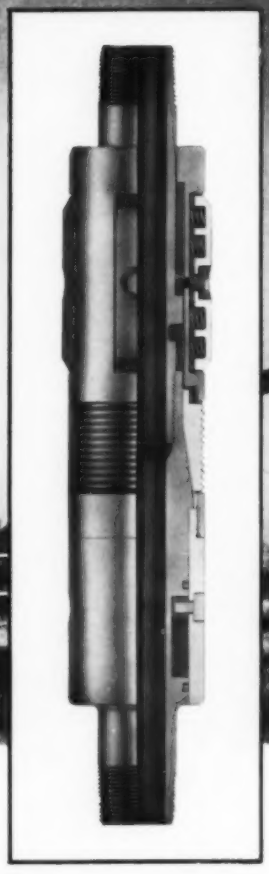
OIL CENTER TOOL CO.

SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

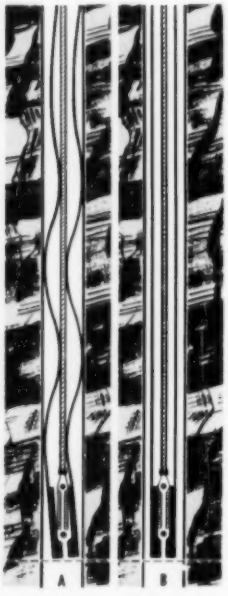
Export Representatives: South America — East West Oiltools, C. A., Del Lago Hotel, Maracaibo, Venezuela. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston, Texas.

ASK US FOR MORE INFORMATION





New American Iron Tension Tubing Anchor prevents costly sucker rod and tubing failures!



(A) FREELY SUSPENDED TUBING buckles on the upstroke and (B) straightens on the downstroke.

IN PUMPING WELLS, the costly buckling, breathing and cork-screwing of tubing can now be prevented *by keeping pumping strings in tension* with the American Iron Tension Tubing Anchor. Once this tubing anchor is set, all movement of the tubing, either upward or downward, is eliminated!

Your pumping-wells become more profitable because the money-saving advantages of the new American Iron Tension Tubing Anchor are MANY!

- Increases service-life of rods and tubing!
- Increases fatigue-life of tubing!
- Increases efficiency of the pump!
- Decreases tubing connection wear!
- Decreases rod-on-tubing wear!
- Decreases horsepower input requirements!
- May be used as Automatic Tension Tubing Anchor . . . Positive Tension Tubing Anchor!

COMPLETELY RETRIEVABLE UNDER ALL CONDITIONS

Under normal conditions, just re-jay and pull. Tubing anchor will retrieve easily. Under adverse conditions, a steady upward pull on the tubing will cause a tensile failure of the relief groove in the slip mandrel extension. The upper portion of the slip mandrel extension then becomes a jar that strikes the inside shoulder at the upper end of the housing. The slips are pulled away from the cone and the tool can be retrieved.

Contact your Supply Store now

AMERICAN IRON & MACHINE WORKS CO., INC. · OKLAHOMA CITY

Another AMF Product
PETROLEUM EQUIPMENT

AMERICAN IRON & MACHINE WORKS COMPANY, INC.
518 North Indiana Avenue • Oklahoma City, Oklahoma
Subsidiary of AMERICAN MACHINE & FOUNDRY COMPANY

Of Things To Come . . . In Oil

SPRABERRY WATERFLOOD PLAN ENCOURAGING since there have been little, if any objections to Sohio's proposed 100-section project. Although engineering details have not been completed, it appears that the favorable reception will bring about positive action this year. When complete, this will be the largest waterflood project in the world.

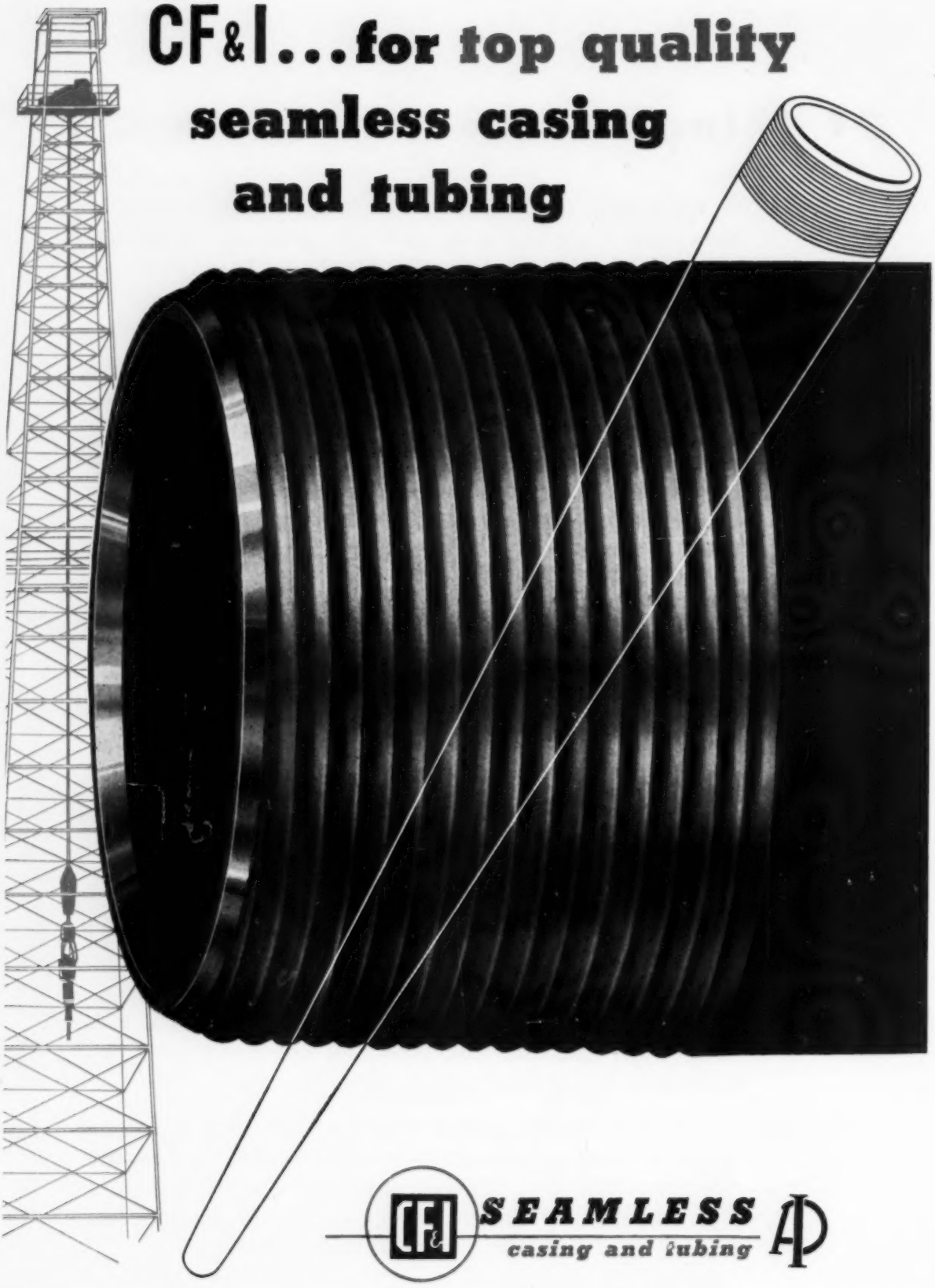
$75 BILLION FOR OIL EXPLORATION IN U. S. in next 10 years necessary to meet growing oil and gas demands, declares Lloyd F. Bayer, senior vice president of Tidewater Oil Company. Risk capital must come from within industry coffers "for government or government-controlled enterprise could not meet this demand at treble the cost," Bayer declared, adding that the easily accessible oil has already been discovered.

1,600,000 BBL PER DAY OIL NEED ON THE WEST COAST is anticipated by 1961, estimates Stancal *Bulletin*. Demand to be met by production: 1,080,000 bbl daily from California; 100,000 bbl from Colorado and Wyoming; 100,000 bbl from Four Corners; 100,000 bbl product receipts via pipelines into the area. Deficit of 200,000 bbl daily could be made up by Trans Mountain line (Canada). Thus all requirements would be met within the immediate area — with foresight, brains, and private capital.

HIGHER STRENGTH DRILL PIPE COMING, for super-deep drilling ahead. In field testing stage is X-135 pipe, with 135,000 psi minimum yield strength. API Grade E drill pipe has a minimum yield of 75,000 psi. Grade V-150 casing (150,000 psi minimum yield strength) being further developed and undergoing field tests, was first used in the world's deepest well in 1955. Material with 200,000 psi minimum yield strength is also being developed, particularly for special clearance couplings.

INDUSTRY MAY AID IN NUCLEAR WASTE DISPOSAL as a result of the API study group headed by T. V. Moore of Jersey Standard. Committee will study problem of radioactive waste disposal to determine if any techniques developed in the oil industry could be used. Deep well disposal at plant site has possibility.

CF&I...for top quality seamless casing and tubing



CF&I SEAMLESS casing and tubing API

THE COLORADO FUEL AND IRON CORPORATION • DENVER, COLORADO

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

SWIVEL FACTS

by

The floating washpipe in an IDECO swivel can be repacked by one man in about 22 minutes, using a sealed packing assembly stocked by your near-by J&L Supply store. Your IDECO swivel is then normally ready for many more wells before washpipe or packing needs further attention.

Everything about an IDECO swivel is just as simple and durable.

You can have straight or tapered main roller bearings. The swivel is available in four sizes, with dead load capacities to 300 tons. The 300-ton job has tandem main bearings. An IDECO cannot be distorted by bail loading.

From Canada to the Gulf of Mexico more IDECO swivels go to work annually, and with good reason. Drillers like them and the good word gets around.

Have the details on file when you need a new swivel — call your J&L Supply store now!

Jones & Laughlin

SUPPLY DIVISION – Tulsa

J&L – A GREAT NAME IN SUPPLIES

15 M

Stopping the winch during the loading of a draw works shows the kind of strain a Mack B-80 is built to take day in and day out. Mrs. Gibson, shown above, is president and active manager of Hoot Gibson Trucking Company, an oil-field hauler in Oklahoma City.

How a woman succeeds as an oil-field trucker!

"I depend upon Macks," says Mrs. Gibson when asked to account for her success as an oil-field trucker. "My husband, who founded this business, put his faith in getting the best to do the most economical job. Since his death, I have carried on in the same manner.

"This is challenging, heavy-duty hauling, often under really adverse conditions. Hub-deep mud, roadless terrain, or over-the-road . . . we have found that Macks do the best job . . . working at top operating economy with a minimum of down time. Our performance and maintenance records prove the superiority of Macks."

Hoot Gibson's records prove it . . . and your records will, too, when you use Macks. Why not see your Mack representative for all the facts on the most complete line of heavy-duty trucks available today. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd.

MACK

first name for

TRUCKS

5649

GETTING CORRECT RING FIT IS EASY WITH

.... Martin Plungers and the Martin Method of Installation*

The rubber-and-duck rings swell **just so much** and no more.

Rings reach maximum size in the well within a few hours.

Dimensional Compensation during the manufacturing process assures the uniform working fit obtained with Martin Split Rings.

The Martin Ring Size Guide Table* assures proper ring size selection for various gravities, temperatures and sand and water content.

Martin Split Rings are made in steps of .005" in diameter, so that you can actually increase or decrease plunger clearance that amount by changing to next larger or smaller size.

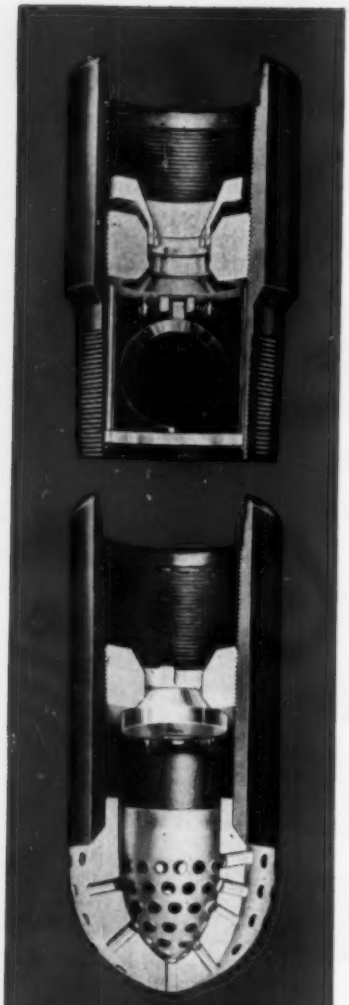
The gaps between the Martin Rings cause fluid turbulence which slows down slippage past the Martin Plunger — just as a rough road slows down your driving speed. Actually, the Martin Plunger maintains pumping efficiency with a looser fit than is possible with a smooth surface plunger.

* See the complete Martin Catalog and instructions in the 1957 Composite Catalog.

JOHN N. MARTIN

Manufacturer

9 W. BRADY • TULSA, OKLA.



You're the Doctor

...when you run casing with

RECTOR TYPE "O"

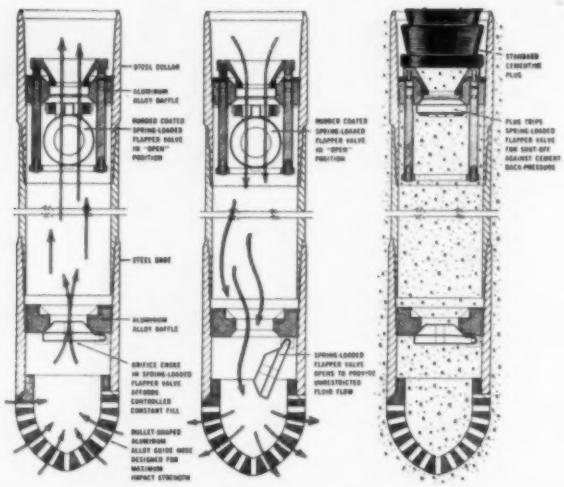
Optional Circulating
FILL SHOE and COLLAR

Rector Type "O" is the ONLY automatic casing fill-up equipment that permits circulating the well at your option, and then continuing to run pipe with controlled fill from the bottom. In cementing the well you use standard heads and plugs. The Type "O" collar provides positive shut-off against back-pressure.

If you need to convert from filling to floating, you can do so quickly by dropping in valve-trip ball at the surface and applying pump pressure.

Type "O" Fill Collars and Fill Shoes, used in combination, are priced competitively with other types of fill-up equipment which do not offer the Rector advantages of optional circulating, protective screening nose, and FULLY DRILLABLE ALUMINUM ALLOY all-metal construction. Prompt delivery through your favorite supply store in O.D. casing sizes from 4½" to 13⅜".

- Controlled casing fill from the bottom with option of circulating and then resume filling.
- Automatic fill-up speeds running time... reduces pressure surges ... protects the formation.
- Spring-loaded flapper valve, with orifice choke, in the baffle assures controlled constant fill.
- Reduces possibility of pipe sticking.
- Converts to float at operator's option.
- Screening nose protects fill equipment from fouling.



FILLING CIRCULATING CEMENTING

RECTOR WELL EQUIPMENT COMPANY INC

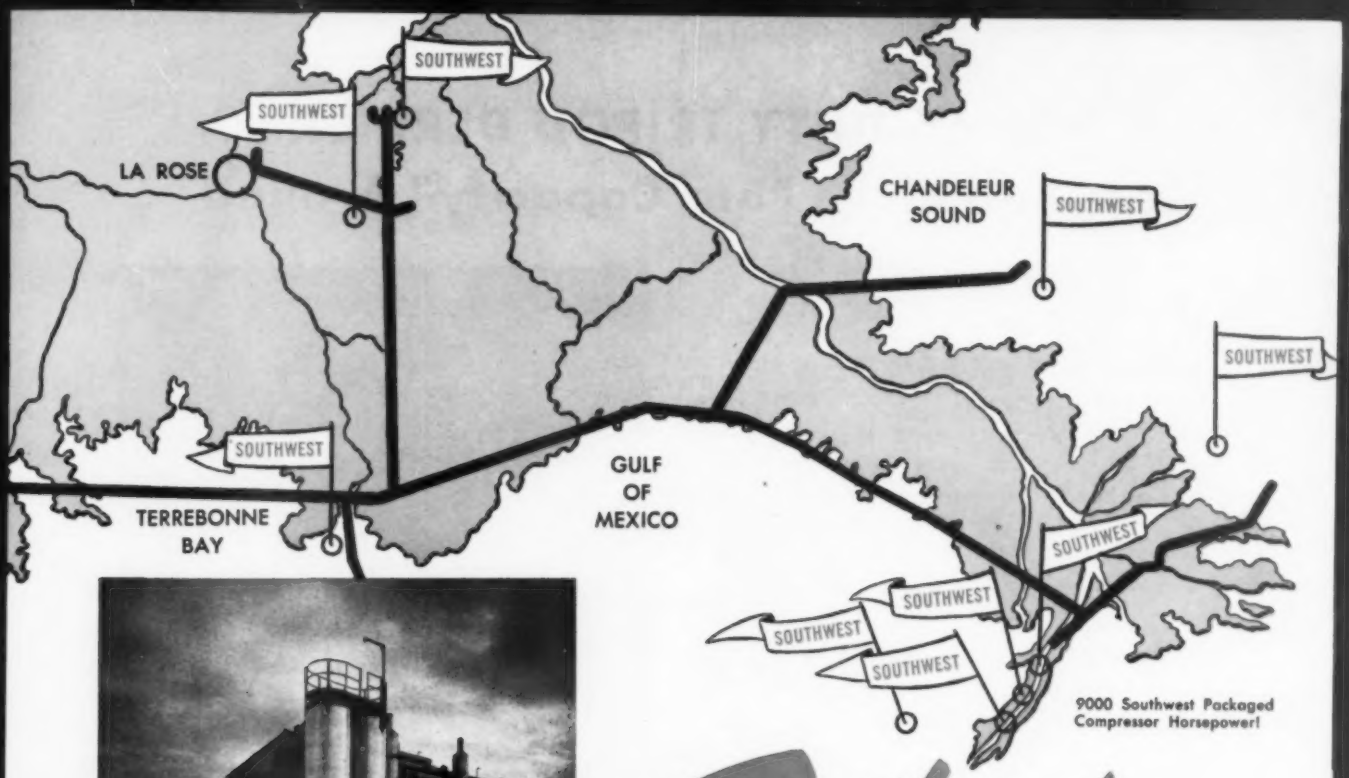
MAKING THE OIL INDUSTRY SAFER

1100 NORTH COMMERCE ST. FORT WORTH, TEXAS

Houston Plant: 2215 Commerce St.

REPRESENTATIVES IN ALL ACTIVE FIELDS

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



Southwest

PACKAGED GAS COMPRESSORS FEEDING "THE MUSKRAT LINE"

From the South Pass area of the Mississippi Delta west for almost 400 miles to Crowley, La., the Muskrat Line lies in swamps, bays, and marshes. Eighty per cent of the line lies underwater! To boost the pressure of gathering lines feeding into it, five majors have turned to Southwest Packaged Gas Compressor Plants. These Southwest units can be installed in any location to do any compressing job. These balanced units can be mounted on piling, concrete platforms, barges, or wherever necessary for most economical installation and operation.

Southwest plants are saving gas producers thousands of dollars in the rugged swamp country of South Louisiana through low installation and low operating costs. Available in sizes from 265 hp to 660 hp.

FOR GAS LIFT, GAS BOOSTER, PRESSURE MAINTENANCE AND SIMILAR PROJECTS.

SOUTHWEST INDUSTRIES, INC.

P. O. Box 19392, Houston 24, Texas

HEAVY-DUTY TRIPOD DERRICK
Lets You Move "Big Capacity" Around

For use with both 36-L and 48-L spudders, Bucyrus-Erie's heavy-duty tripod derrick has sufficient height and stability to handle casing loads up to 300,000 pounds when rigged for 10-part hoist. Completely raised, the derrick is 70′ 4″ high.

Despite the derrick's size, spudder mobility is retained. Erected in five easy steps, this derrick is easy to tear down and move. Each of the five units can be disassembled and transported separately. Look: 45557

36-L Top-to-bottom drilling to 3,500 feet. Servicing to 4,000 feet. Swings up to 5,000 pounds of tools.

48-L Top-to-bottom drilling to 6,000 feet. Servicing to 7,000 feet. Swings up to 6,700 pounds of tools.

BUCYRUS ERIE

Write today for complete information.

BUCYRUS-ERIE COMPANY
South Milwaukee, Wis.

1. Derrick sections are assembled on the ground. Legs are hinged to the base and the gin pole is set in place preparatory to raising derrick.

2. Using the bull reel drum for hoisting, the derrick begins to rise. Hinged front lower section is pulled into place by the derrick hoist.

3. When the derrick is completely raised, the gin pole is removed and the front lower section is attached.

BAROID...

The muds that put profits on your books . . .

. . . How? By reducing costs through new and better products, services and techniques.

No single item of drilling expense can be as important to profits as the muds you use and Baroid muds *make equipment work better;* Baroid muds *reduce down time;* Baroid muds *make better completions.* And all the while Baroid muds get effective penetration at more economical mud costs.

Every Baroid engineer, production man and research technologist knows that a better mud that will reduce your costs will make more profits for you and make a better customer for Baroid.

Get Baroid on the job . . . and profits on your books!

When you buy Baroid -- you buy the Best!

BAROID

BAROID DIVISION • NATIONAL LEAD CO.
Main Office: P. O. Box 1675, Houston 1, Texas

5788

New From Baroid

DOUBLE-BARRELED MUD SYSTEM PROTECTS ZONES, DRILLS DEEPER

Drill faster and deeper with these new DMS and DME brand mud chemicals. Use them with or without emulsified oil for a "surfactant mud" system that is attracting wide engineering interest.

DMS & DME brand additives produce a mud that keeps fluid out of cuttings and formations, provides more efficient removal and recovery of cuttings, and resists high temperatures at great depths. Write for engineering report.

*A trademark of Magnolia Petroleum Company

When you buy Baroid—you buy the Best!

BAROID DIVISION • NATIONAL LEAD CO.
P. O. Box 1675, Houston 1, Texas

Please send me your bulletin on DMS & DME.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

- Less solids build-up in mud
- Minimizes formation damage
- Easy to run and cement casing
- Permits use of inhibited mud with low resistivity
- Inhibits hydration and dispersion
- Holes remain close to gauge
- Not affected by salt waters
- Stable to high bottom-hole temperatures
- Bits and drill pipe last longer

BAROID

BAROID DIVISION • NATIONAL LEAD CO.
Main Office: P. O. Box 1675, Houston 1, Texas

5789

Why buy 2 rigs...when 1 will do?

New Case® TerraTrac® "2-in-1" Loader-Dozer

Saves investment!
Cuts operating cost!

If you need a front-end loader, as well as a dozer — but don't have full-time work for *both* — there's no longer any need to buy *two* machines and hire *two* separate operators to run them.

Now, for only a few dollars more than the cost of a *single*-purpose rig, you can get a *multi*-purpose Case TerraTrac crawler, with combination loader and dozer. This gives you the *versatility* of two highly efficient work-tools, with the *economy* of one tractor, one hydraulic system, and one operator.

With optional *bulldozer or angledozer*, you can clear land, build access roads, do light stripping, filling, etc. Then you simply pull four pins . . . detach dozer and lift arms . . . and you're ready in 5 minutes to work the *loader* . . . for loading trucks and hoppers, stockpiling, materials-handling, clean-up, and many other jobs.

Capacities up to 2 cu. yds.

Case TerraTrac combination loader-dozer units are available in 10 gasoline and diesel-powered models — *from 42 to 100 HP, with ⅝ to 2-cu. yd. buckets.* Largest models feature torque-converter drive and exclusive counter-rotating Terramatic transmission, with instant power-shift, and power-steering, which give you much higher working speeds and greater ease of maneuverability than any conventional crawler tractor. These larger Case TerraTrac units also give you the important advantage of torsion-bar track suspension and automatic track roller lubrication, which cuts greasing time from once a day to a few times a year. Mail coupon today for complete facts on sizes best suited to your needs.

CASE

1st in quality
for over 100 years

Clip . . . mail for free catalog

J. I. CASE CO., Dept. B1308, Racine, Wis., U.S.A.

Send free catalog on Case TerraTrac loader-dozer units checked.

☐ 2 yd. ☐ 1½ yd. ☐ 1 yd. ☐ ¾ yd. ☐ ⅝ yd.

Name ..... Title .....

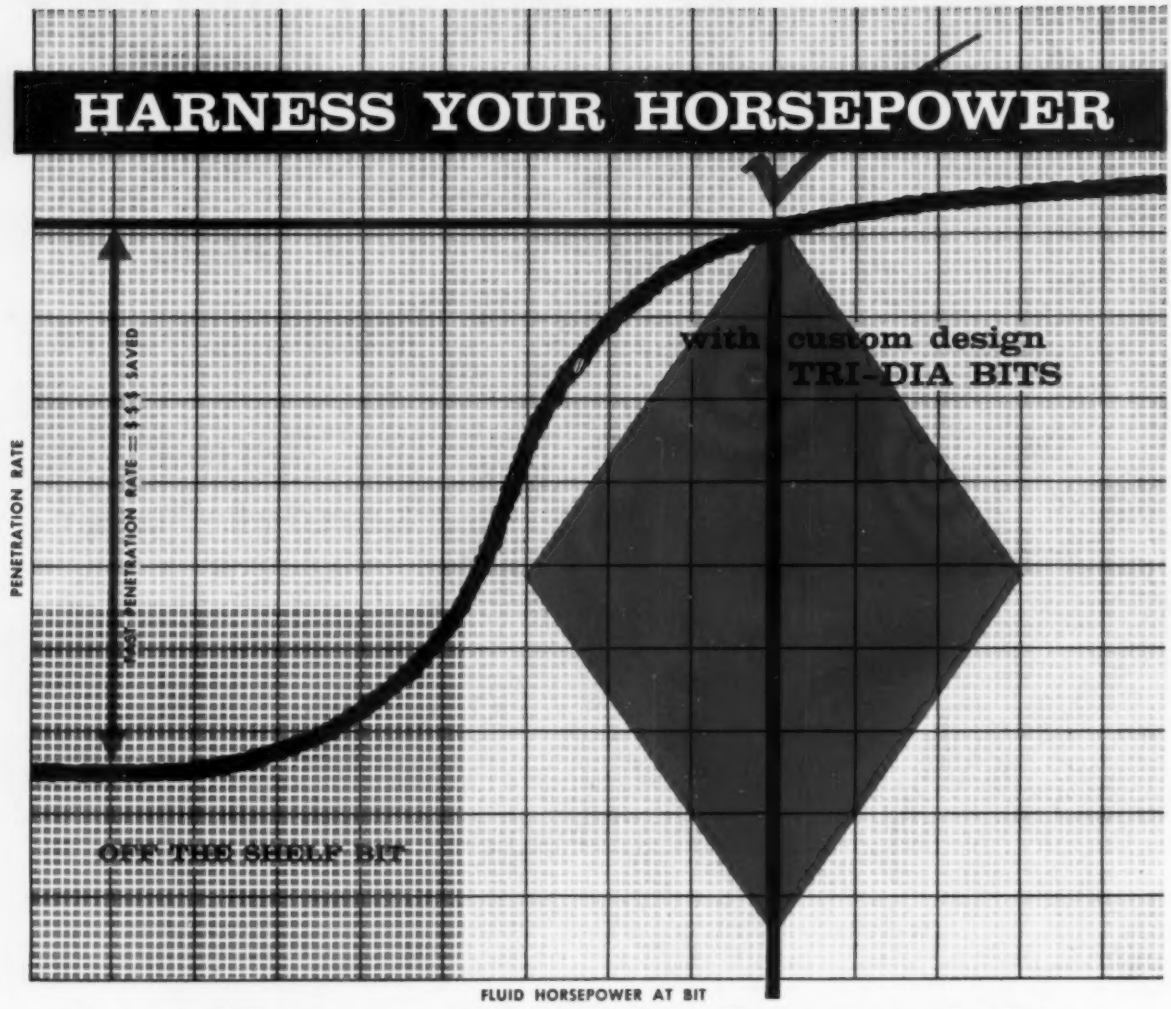
Company .....

Address .....

City ..... State .....

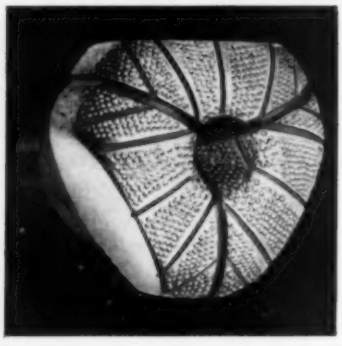
CT-LD-74

Industrial Wheel and Crawler Tractors • Loaders • Dozers • Backhoes • Engines



Save Money with D&S Diamond Bits

You use ALL available horsepower with D&S custom designed bits...NOT a small fraction of it!



JET ACTION BUILT INTO D&S TRUCO DIAMOND BITS!

Careful advance planning regarding D&S "jet action" Diamond Bits to be used is as important as planning the rest of your drilling program. Tri-Dia Bits should be ordered to fit specific conditions to give efficient peak performance on your job. ORDER YOUR D&S BITS TO FIT . . . (1) Volume circulated, (2) type mud, (3) formation, and (4) rock bit footage.

WRITE OR CALL TODAY! One of our sales engineers will call on you and explain this revolutionary new Diamond Bit.

DIAMOND DRILLING EQUIPMENT
6210 N. CENTRAL EXPRESSWAY DALLAS, TEX.
OFFICES IN ALL PRINCIPAL OIL AREAS

Drilling & Service INC.

UNIBOLT
flow manifolds

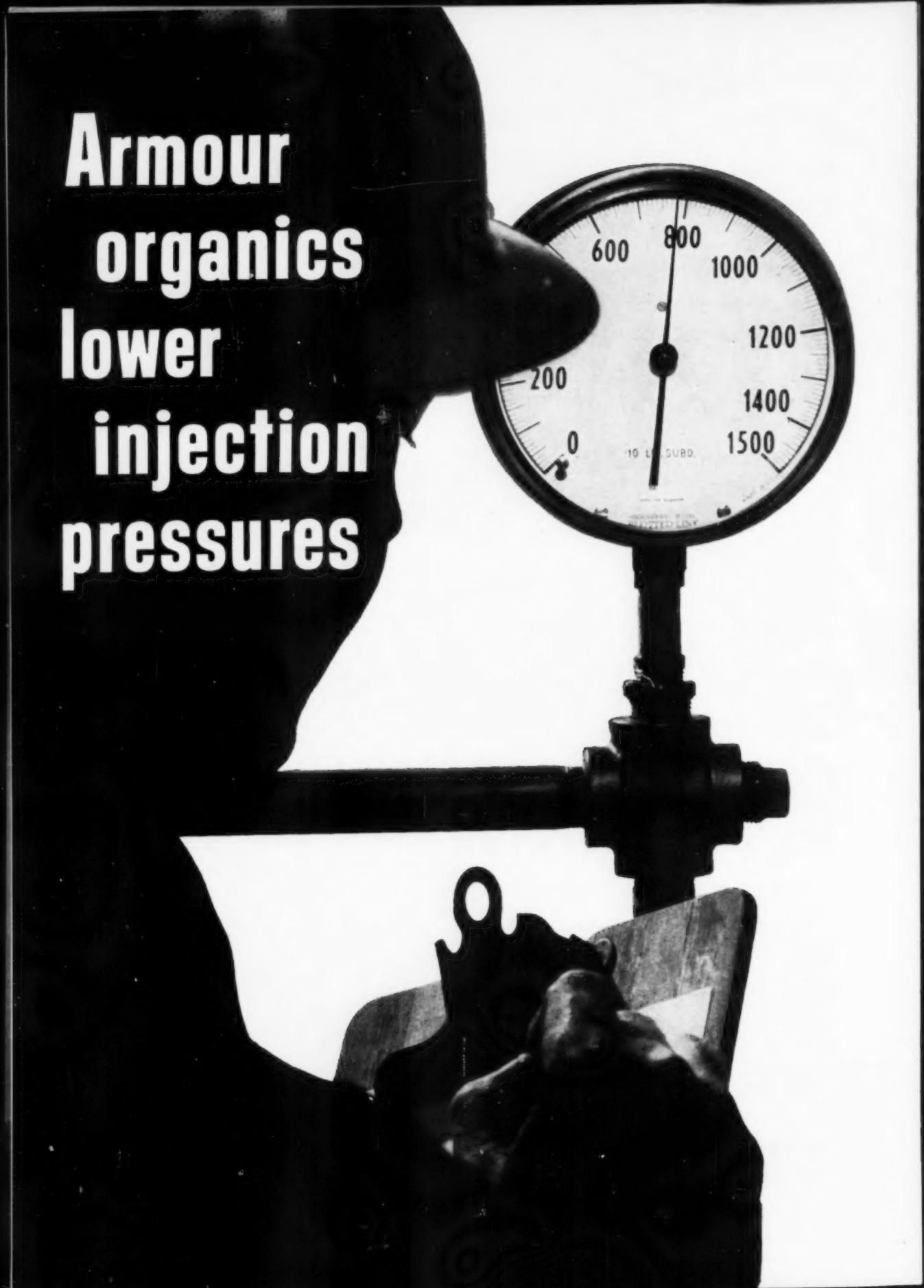
More and more operators are requesting their Christmas tree supplier to furnish UNIBOLT Flow Manifolds because they are lighter in weight, stronger, economical and easier to maintain.

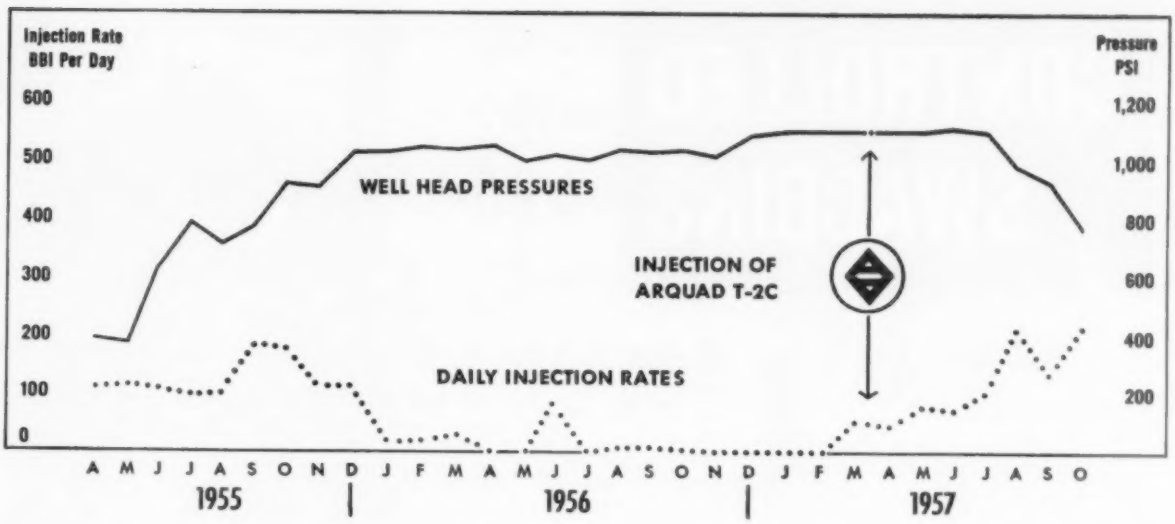
Employing standard UNIBOLT connections rather than flanges, the UNIBOLT Flow Manifold is many pounds lighter, yet the UNIBOLT design, which places more steel in shear, actually results in a higher factor of safety for the manifold.

The three parts of the manifold — UNIBOLT Tee or Cross, Adjustable Wing Valve, and Positive Choke Body — are pressure-tested as a unit and may be assembled in a number of combinations to best meet individual needs. They are furnished in regular forged steel or in high-chrome alloy for corrosive wells — 6,000, 10,000 and 15,000 lbs. test.

The manifold is completely salvageable, either as an assembly or as individual units. Since all of its connections are standard UNIBOLT design, each unit freely interchanges with any other UNIBOLT product of the same size and rating.

THORNHILL CRAVER CO.
P. O. BOX 1184 HOUSTON, TEXAS


Armour
organics
lower
injection
pressures
600
800
1000
1200
200
1400
0
1500



Well head injection pressure down from 1100 to 780 pounds, injection rate up from 30 to 220 bbls. per day at eastern Oklahoma water flood. This performance chart offers recent, conclusive proof how an Armour organic, Arquad® T-2C, makes possible more efficient oil recovery.

Armour organics stop corrosion—control bacteria. And by lowering surface tension of water they increase injection rates and decrease pressures for more efficient oil recovery!

Armour water-flood chemicals Armac® CD-50, Arquad® 12-50 and Arquad® T-2C are being used to lower injection pressures. These polar organic surfactants produce a detergent effect in water that apparently "scrubs" more residual oil from sand surfaces, often resulting in increased oil recovery.

Reports from several other water floods, already using Armour cationic chemicals to inhibit corrosion and combat bacteria, also reveal this additional, important benefit. In many instances these chemicals decreased injection pressures by lowering surface tension and dispersing foreign materials.

In many water floods, the action of Armour cationics have prevented scale deposits. The detergent and bactericidal effects of Duomeen® CD-50, Armac CD-50, Duomeen CDA-50 and Arquad T-2C have improved back-washing efficiency of all types of filters. The use of these chemicals ahead of the filters increases filter efficiency—especially diatomaceous earth filters.

For more than 8 years Armour chemicals for oil production have been used in oil fields all over the world. The most successful water-flood units are today using Armour cationics for *complete* bacteria control and as high as 99.5% corrosion protection. Through the years these same chemicals have demonstrated their ability to lower injection pressures, making them of even greater value to the oil industry.

For further information, send the coupon below.

Leader in Progressive Fatty Acid Chemistry

ARMOUR CHEMICAL DIVISION

© Armour and Company
Chicago 9, Illinois

MORE IMFORMATION ON HOW TO INCREASE OIL RECOVERY PE 2-58

☐ Send booklet "Armour Organics for Increased Oil Production."

☐ Send samples of _____
(fill in chemical desired)

☐ Application information on _____

_____

☐ Treatment procedures for _____

_____

Name _____ Title _____

Firm _____

Address _____

City _____ State _____

(Offer limited to North American Continent)

Armour Chemical Division • 1355 West 31st Street • Chicago 9, Illinois

CONTROLLED SWABBING

with Guiberson Swabs

When you're ready to unload or swab test your well, Guiberson fast-falling swabs will do your job at the lowest possible cost.

You get better control of swabbing costs through selection of proper cup size and type. You can match the cup to the situation . . deep or shallow wells . . light, medium or heavy loads . . smooth, rough or tight tubing.

You get maximum control of results, too, when you use the right cup for your particular job. Maybe that calls for lifting lots of fluid fast . . or lighter loads at slower speeds to protect a permeable sand face. One of the several types of Guiberson cups in a wide range of sizes will suit the circumstances and you can put the well on production quickly.

Lift more fluid in fewer trips with Guiberson's fast-falling, smooth-pulling swabs.

Cups are compounded to Guiberson's exclusive formulas for maximum balanced resistance to oil . . acid . . abrasion.

THE
GUIBERSON
CORPORATION

ESTABLISHED 1919
DALLAS, TEXAS
U. S. A.

Sold by
Oil Field Supply Stores
Everywhere

How TORQUE CONVERTERS help make hole *FASTER, CHEAPER!*

The only successful way of getting oil out of the earth is to go down after it—with horsepower. The trick is: how to transmit horsepower efficiently and profitably. And that's where Twin Disc Torque Converters come into the picture.

Twin Disc Torque Converters have been used in almost every type of oilfield equipment application . . . used for increased production . . . used for reduced machinery maintenance . . . used for greater over-all profits. And here are seven good reasons why:

1. Twin Disc Torque Converters (three-stage) offer the highest engine output torque multiplication—up to 6:1 if the load requires it.

2. They eliminate engine lugging and stalling . . . permit engines to work in their most efficient speed range, producing maximum horsepower output whenever required.

3. They match drilling speed to compensate for varying degrees of earth formation hardness . . . for highest drilling efficiency.

4. They permit holding and controlling loads such as drill pipe simply through throttle manipulation . . . for greater accuracy in delicate operations and greater all-round safety.

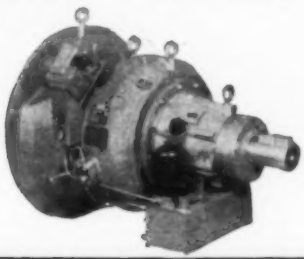
5. They give mud pumps a new degree of flexibility. While engines operate at constant speed, torque converters permit pumps to operate at varying speeds according to load demands . . . to maintain steadier, higher pressures with a minimum of liner changes.

6. They permit more efficient engine operation by improving load balance in applications where engines are compounded.

7. Because of their fluid connection, they dampen out destructive shocks and vibrations between engines and driven equipment . . . for longer lasting machinery life . . . and less downtime for maintenance and parts replacement.

Leading oilfield equipment manufacturers everywhere offer Twin Disc Torque Converters either as standard or optional equipment . . . to provide their customers with these seven profit-making advantages.

Twin Disc Torque Converters are available in both three-stage and single-stage designs . . . to 1000 hp in capacity . . . and therefore Twin Disc engineers can offer completely unbiased recommendations for torque converter applications.



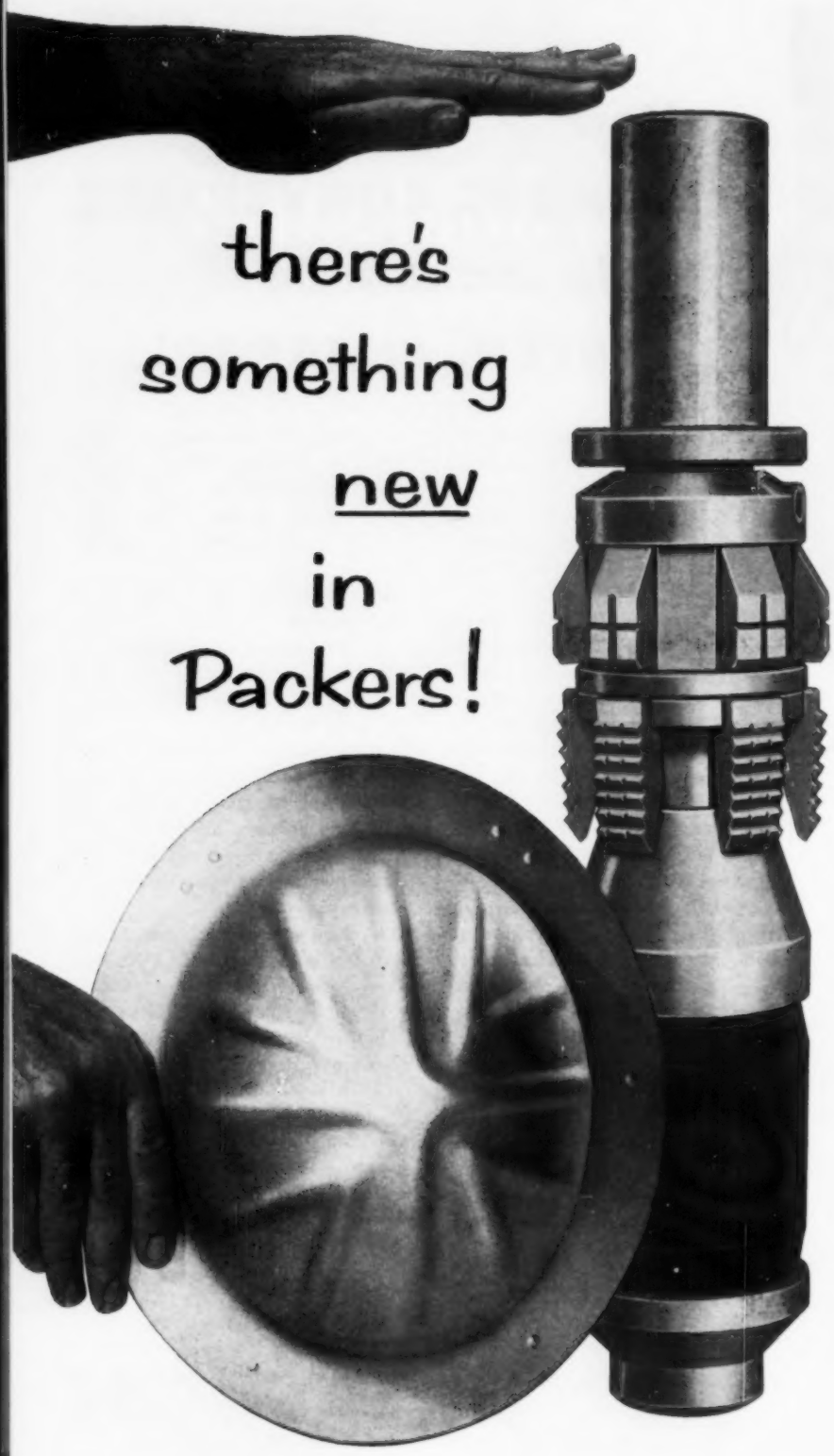
TWIN DISC

TWIN DISC

Friction Clutches and Fluid Drives

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin • HYDRAULIC DIVISION, Rockford, Illinois

BRANCHES OR SALES ENGINEERING OFFICES: CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEWARK • NEW ORLEANS • TULSA



there's something new in Packers!

Where there is a need... Baker shows the way. Recognizing a need for an economical, retrievable and yet dependable packer for water flooding and other pressuring applications in shallow or low fluid wells, Baker engineers have come up with the new Model "A" Tension Packer.

Compact design makes the big difference in this new packer. Imagine the ease of shipping, storing and handling a packer less than 30" long. Its size is deceptive, for it contains many field-tested features of Baker retrievable squeeze tools.

For example, there's a "full bore" to permit the passage of instruments through and below the packer; a proven packing element that assures positive pack-off; and *rocker-type slip units* that eliminate cumbersome drag springs, slip tie-links, and guide grooves. For simplicity of operation, there's the reliable J-Slot setting and release mechanism.

Get to know the Model "A" better. There *is* something new in packers, and your Baker man has all the facts. Call him for information on how the Baker Model "A" Tension Packer can solve *your* hook-wall packer needs, or write for Bulletin No. 334.

PRODUCT NO. 739-A

BAKER
OIL TOOLS, INC.
HOUSTON • LOS ANGELES • NEW YORK

MODEL "A"
TENSION PACKER

Oil field camp in the wilds of Colombia's Middle Magdalena Basin of northern Colombia. This is Shell's Cantagallo camp with the Cimiterra River in the background.

— Courtesy Shell Condor, S.A.

Two Major Provinces Predominate in . . .

Colombia's Geological Features

Half mountainous, half lowland, Colombia's general geology is well defined . . . but dense jungle hinders work of exploration parties in many areas

W. C. Hatfield
Consultant Geologist,
Freedom, New Hampshire

COLOMBIA is a country where the discovery rate in the search for new oil should be high during the next few years. Exploration activity is increasing and should lead to some very interesting results. Indications of petroleum ranging from tar specks, staining, and saturation to large active oil seepages are found almost everywhere in Colombia where all or part of the Cretaceous, Eocene, and Oligocene sediments occur, and many of the discoveries to date were made following these leads. Discoveries range from a few barrels to the Infantas-La Cira field which has been referred to as a billion barrel field, probably without stretching the truth.

Production in the country during 1957 from 15 producing fields will average about 128,000 bbl per day from an average depth of 5000 to 7000 ft. Production is from the Cretaceous and Lower Tertiary. Gravity of the oil in general runs higher from the Cretaceous than from the Tertiary and increases with depth, but there is no significant difference in other properties of the crude.

Colombia is at the northern end of the Andes Mountains and extends eastward beyond this belt of uplift onto the western flank of the Guayana Shield, two basic conditions which have resulted in the formation of two distinct structural and topographic

The Author

W. C. "Luke" Hatfield, dean of Colombian geolgists, has just completed more than 20 years in Colombia, mostly as chief geologist with the Texas Petroleum Company. He is a graduate of Wesleyan University, geology major, and received his PhD in geology from Columbia University. He also spent several years in South Africa for British mining interests. He has recently retired to become a consulting petroleum geologist with headquarters at Freedom, New Hampshire.

provinces into which Colombia is readily divisible. The larger eastern province is flat lowland which reflects a gentle westerly dip of the essentially continental Tertiary sedimentary section resting on pre-Cretaceous and crystalline Shield rocks. The latter outcrop along the eastern international border.

The smaller western province is mountainous with deep intermontane strike valleys and is highly folded and faulted with a structural trend NNE essentially parallel to the Shield margin. Rocks of particular interest to the oil industry in Colombia are marine and volcanic Cretaceous and marine and continental Tertiary resting on essentially pre-Cretaceous red beds and crystalline rocks. Production of oil in Colombia up to the present is entirely from lowland areas in the western province.

Many parts of Colombia have not been mapped geologically in detail, but enough work has been done to yield a reasonably good regional picture and to outline the various basins and their development. The regional viewpoint related particularly to the oil-bearing formations will be emphasized in this article.

THE EASTERN PROVINCE

The Guayana Shield rocks are exposed along the eastern border of Colombia and extend for a long distance to the west at a shallow depth under the Tertiary as a broad arch that nearly separates the province into northern and southern basins. The northern basin is the open grassland of the Llanos, and the southern basin is the dense tropical jungle-covered Caquetá Basin.

Guayana Shield

The Shield rocks are mostly coarse soda-rich igneous types bordered by Paleozoics and probably Lower Mesozoics dipping into the geosyncline of the mountain area to the west. The Paleozoics are marine black shales and quartzitic sandstones which show varying degrees of metamorphism. Our scanty knowledge of these rocks is based mostly on outcrops in the mountainous areas to the west where limestones, quartzites, and conglomerates also are found with a gradation to red-bed facies in the upper part of the section. Over-lying the Paleozoics and below the overlapping Cretaceous in the mountains is the Lower Mesozoic red-bed complex which probably does not extend very far east into the area of the eastern province.

All the pre-Cretaceous section is considered as effective basement at present and usually is unconformable with the overlying beds. In the eastern province the Cretaceous and Tertiary pinch out by easterly transgressive overlap, and, with rare exceptions, only Upper Tertiary to Recent sediments are exposed at the surface. The Lower Tertiary is exposed in a narrow belt of foothill folds along the western side close to the mountains and is almost everywhere in faulted contact with the mountain forming Cretaceous.

The Cretaceous in the adjacent mountains is a thick section of marine sandstones with a lesser amount of marine black shales and thin limestones. Regional distribution and the depositional features of the sandstones indicate an easterly source, and it is highly probable that the Cretaceous pinches out not far east of the mountain front. Mesa-like sandstone remnants occur in many places in the eastern Caquetá Basin, some of which are feldspathic in the lower part, and which are considered by some to be Cretaceous. If they are, then the Cretaceous overlapped the Shield area a long distance as sandstones, but the author is of the opinion that these remnants are probably what is left of the source sands of the Cretaceous and hence are similar lithologically.

The Tertiary in the eastern province is continental but contains large thicknesses of black shales with arenaceous forams which become calcareous toward the north. Oil shows and active seepages are prolific in places, usually associated with the lower sandstones. The Paleocene is conformable with the Cretaceous but unconformable with the overlying Tertiary and is composed of vari-colored claystones with carbonaceous streaks, a characteristic transition over most of Central Colombia from the Cretaceous to the Tertiary.

A major unconformity occurs at the top of the Paleocene on which rests the well known Eocene Mirador sandstones, except in the Caquetá Basin where there is a major local facies change in the Lower Eocene to quartz conglomerates and siliceous claystones. The Oligocene is comprised mostly of black shales with a few sand breaks in the lower part, and silts, clays, and sandstones with abundant macrofossils in the upper part. The Miocene has a larger proportion of coarser clastics.

In summary, in the Caquetá Basin the Cretaceous is marine shales and limestones overlain by Tertiary beds, and in the Llanos is essentially marine Cretaceous sandstones with minor interbedded shales overlain by Tertiary beds, but the overlapped pinchout of the Cretaceous in both cases is not far east of the mountain front.

THE WESTERN PROVINCE

The western province is divisible into three basic parts, the Eastern Geosyncline, the Central Cordillera, and the Western Geosyncline.

At the beginning of the Cretaceous the Central Cordillera was a low, positive area that extended south into Ecuador and north to include the Santa Marta Mountains. The latter point is controversial technically, but practically it makes a good working hypothesis since there is no known Cretaceous, nor Eocene, in the area along the trend of the present Central Cordillera and the Santa Marta Mountains. The collapse of this area was during the Oligocene. The Eastern Geosyncline existed during the Cretaceous just to the east of this land mass with its axis essentially along a line through Mocoa, Bogotá and Cúcuta and its eastern flank transgressing onto the Guayana Shield. It extended south into the Amazon Basin in Ecuador and north into Venezuela. The Western Geosyncline occurred along the western side of the Central Cordillera positive area, and there is no clear evidence that the seas of the two geosynclines joined across the central barrier at any time during the Cretaceous.

Sediments in both geosynclines are broadly similar, but the fossils in the west have a North American affinity and those in the east are more European. Sections in the Western Geosyncline are poorly exposed, mostly marine black shales, but south of the Sinu Basin are interbedded with volcanic

clastics and flows in increasing amounts going south. The northern end of this geosyncline is called the Sinu or Bolívar Basin, and there the sediments appear to be more similar to those of the middle Magdalena Valley. The west flank of the eastern geosyncline shows a transgressive overlap of the Cretaceous onto the crystallines of the Central Cordillera with a basal redbed section exposed in places below an otherwise quiet marine black shale and limestone section with minor sand breaks. The Central Cordillera was evidently a lowland area from which es-

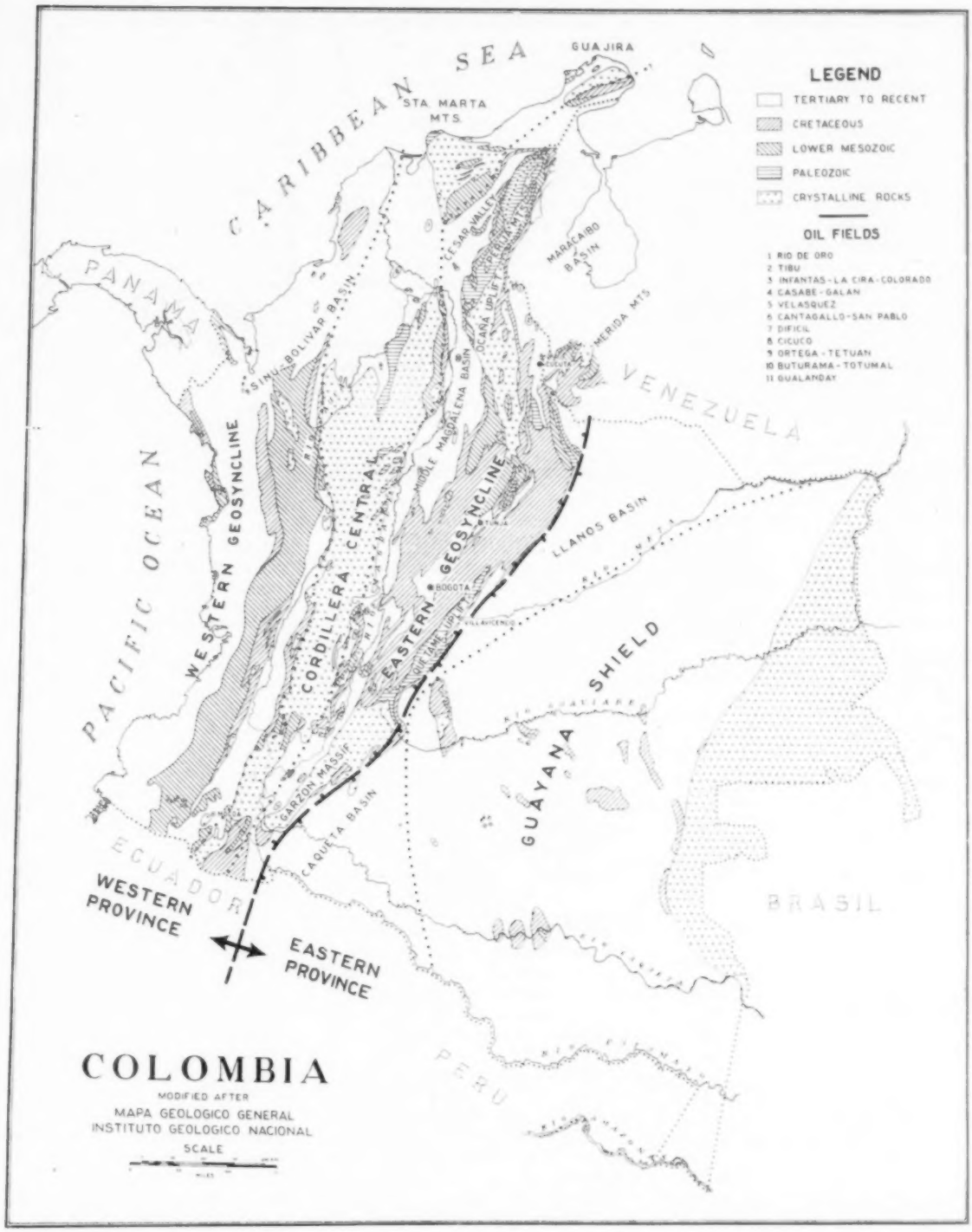


FIG. 1. **General geological map of Colombia** showing two distinct structural and topographic provinces into which the country is readily divisible. The Guayana Shield, the larger eastern province, is flat lowland which reflects a gentle westerly dip of the essentially continental Tertiary sediments. The smaller western province is mountainous with deep intermontane strike valleys and is highly folded and faulted.

sentially only muds were being derived, but the volcanic activity that dominated the section in the southern part of the Western Geosyncline is reflected in the Eastern Geosyncline by the presence of several widespread chert and siliceous shale horizons.

The Eastern Geosyncline

The eastern geosyncline includes the area between the eastern province lowlands and the Central Cordillera-Santa Marta-Guajira crystalline rock trend. It was intensely folded in late Miocene to Recent times into an anticlinorium forming the Eastern Cordillera and Perijá Mountains in Colombia and the Mérida Mountains in Venezuela. The southern end of the Cordillera plunges and terminates in Colombia, but the northern end forks as the Perijá and Mérida Mountains, leaving the Maracaibo Basin in between as a lowland area. The southwestern end of the Maracaibo Basin extends into Colombia, where the Barco fields are located. A narrow belt along the western flank of the geosyncline remained as the present day lowland of the Magdalena and Cesar valleys.

Since the main mountain building activity did not occur until late Miocene or later, there is considerable similarity in the Cretaceous and Tertiary stratigraphy over the entire area of the original geosyncline, except that the Tertiary becomes more marine in the north. In general the section in Colombia is continental Tertiary resting on marine Cretaceous above what is considered at present as effective basement. The latter is comprised of Lower Mesozoic red-beds and volcanics, with marine facies along the western flank, above metamorphosed essentially marine Paleozoics. The Cretaceous is comprised largely of marine black shales with only a few reservoir beds, the limestone reservoirs depending upon fractures for permeability and the few sandstones frequently fresh water flushed.

The Cretaceous sands up rapidly east of the axial line of the geosyncline, and the evidence is very clear that the Guayana Shield was the major source area for the coarser clastic material. There are also local lithologic variations in places in the geosyncline that indicate local sources of material, among which were the Garzon massif northeast of Mocoa, the Quetame uplift west of Cúcuta, and perhaps another along the Perijás. The Ocaña uplift appears to be an old feature that preserved its identity with a trend different to that developed during the post-Cretaceous in the rest of the geosyncline, and it and the Perijá Mountains join today to form the western limits of the Maracaibo Basin.

Toward the end of the Cretaceous the eastern source area was rejuvenated, and during the widespread deposition of sands along the eastern flanks of the geosyncline the seas retreated to the north. Deposition of marine shales persisted longest west of the Ocaña uplift and south along the present Magdalena Valley to just a few miles north of Ibague. The Paleocene is also essentially marine shales and silts along this belt with practically no sandstones. The eastern limits of this apparently local basin conform with the curvature of the trend of the present day Cordillera, which suggests that a sort of barrier existed during the Cretaceous, and also during the Tertiary, since the latter sediments are also slightly different from those elsewhere. This local basin is referred to as the Middle Magdalena Basin. It was protected from the influx of sands coming from the east during most of the Cretaceous.

During the latter part of the Cretaceous, while the seas were receding from the geosyncline, the main drainage was toward the northeast across the Cúcuta district where a series of sandbars and braided stream deposits were laid down. A red-bed essentially claystone series was deposited conformably above the Cretaceous sandstones over most of Colombia east of the barrier during the Paleocene. Swamps were widespread, and extensive deposits of coal were formed.

The deepest part of the geosyncline appears to have been in the general vicinity of Bogotá-Tunja where the older part of the section is better developed, and up to 70,000 ft of Cretaceous have been reported.

The close of the Paleocene and the withdrawal of the sea from the Eastern Geosyncline was quickly followed by local folding of new areas within the geosyncline and renewal of the older uplifts. The movement in these areas was sufficient to result in non-deposition of the Eocene in places and to cause erosion deep enough to expose the pre-Cretaceous locally. The Ocaña positive trend continued to act as a semi-barrier during the Tertiary. The

	EASTERN GEOSYNCLINE		
	MIDDLE MAGDALENA BASIN	EASTERN CORDILLERA	BARCO
PLEISTOCENE	MAGDALENA	PAIPA	TERRACES
PLIOCENE	MESA	TILATA	NECESIDAD
MIOCENE	REAL	?	GUAYABO
OLIGOCENE	COLORADO MUGROSA	USME	LEON
EOCENE	ESMERALDAS LA PAZ	BOGOTA MIRADOR	CARBONERA MIRADOR
PALEOCENE	LISAMA	GUADUAS	LOS CUERVOS
CRETACEOUS	UMIR	GUADALUPE	BARCO CATATUMBO MITO JUAN COLON
Cherty beds	GALEMBO		LA LUNA
	PUJANA SALADA SALTO SIMITI TABLAZO	VILLETA UNE	COGOLLO AGUARDIENTE
	PAJA ROSA BLANCA	CAQUEZA	MERCEDES TIBU
	TAMBOR	ARCABUCO	?
	GIRON	GIRON	BASEMENT

FIG. 2. **Geologic column of the Eastern Geosyncline,** including the Middle Magdalena Basin, the Eastern Cordillera and Barco. Many of Colombia's producing fields are located in this region.

Tertiary in the Middle Magdalena Basin can be readily correlated lithologically with the rest of the geosyncline, but it is distinctly more coarsely clastic, and in spite of its otherwise typically continental characteristics the Eocene and Oligocene appear to contain connate salt water. The uppermost Oligocene frequently shows a transition, however, to the fresh water of the Miocene. The evidence suggests an inland shallow salt water basin with deposition rapid enough to prevent the formation of evaporites.

Several major oil fields occur in the Middle Magdalena Valley, and a detailed description of these and the stratigraphy can be found in some of the references listed in the bibliography. Practically all the production is from the Paleocene, Eocene, and Lower Oligocene, which are comprised of lenticular siltstones and sandstones with interbedded multi-colored claystones. In the remainder of the Oligocene the claystones exceed the sandstones, and in the Miocene the sandstones are pebbly and continuous over large areas with sharply interbedded claystones that are uniformly gray to greenish. The pebbles are usually well rounded volcanics, chert, and quartzites.

East of the barrier area the basal Eocene is two sandstones with a carbonaceous shale break. This formation was derived from the Shield area, except in the Upper Magdalena Valley where it is usually a chert conglomerate and in the Caquetá Basin where it is a milky quartz conglomerate, both associated with white siliceous clays. The remainder of the Tertiary sections in the east is a series of claystones, siltstones, shales, sandstones, and pebbly sandstones that are more fossiliferous than to the west and reflect fresh water current deposition, except during a part of the Oligocene. Quiet fresh water conditions seem to have existed over an extensive area during the Oligocene during which black fossiliferous shales were deposited. The fossils in these shales, however, became brackish or marine near the Venezuelan border.

The Maracaibo Basin extends southwest into Colombia for a short distance near Cúcuta between the Perijá and Mérida mountains. It is a highly petroliferous area in Colombia as in Venezuela, with production from both the Cretaceous and the Tertiary. This area has been fully described in the publication by Notestein, et al, listed in the bibliography.

Exploration drilling in the overall geosynclinal area has been spotty and localized and much of the area remains to be tested, but in the areas where drilling has been concentrated several fields have been discovered. The fields in the Maracaibo Basin area near Cúcuta yield about 20 percent of the present production of Colombia, the middle Magdalena fields about 75 percent, and the remainder is from the Upper and Lower Magdalena Valley areas.

The Upper Magdalena Valley was beyond the influence of the suggested Ocaña barrier, and the Paleocene and uppermost Cretaceous are red-bed claystones that make an excellent seal for the Cretaceous. The three oil discoveries in this area are in the Cretaceous in thrust faulted anticlines with no significant breaks in the stratigraphic sequence except at the base of the Tertiary. This area is complicated structurally but undoubtedly will yield several more discoveries as it becomes better understood.

The Western Geosyncline

The Western Geosyncline extends from the western edge of the Central Cordillera, essentially along the Cauca Valley, to beyond the coast line, and is divisible into the Pacific and Atlantic Coast basins and the Western Coastal Cordilleras. Knowledge of the geology of this part of Colombia is very limited and spotty, due to rough topography and heavy rainfall, except in the Atlantic Coast Basin.

Pacific Basin. The Pacific Basin is rugged, jungle covered, tropical lowland with heavy rainfall. The area has been steeply folded, but a few large anticlines with gentle dips are known in the younger Tertiary near the coast. Marine Cretaceous rocks outcrop in only a few places along the flanks of the northern part of the basin and consist mostly of black shales and silts. The fossils have a North American affinity. Overlying the Cretaceous are some 30,000 ft of Tertiary to Recent sediments, probably with a major unconformity because the Lower Eocene has not been reported at present. Marine conditions persisted up through the Lower Miocene, and sediments ranging from shales to argillaceous sandstones were deposited with very little clean sandstones, limestones, and conglomerates. Conditions changed during the Lower Miocene, and the upper section becomes increasingly brackish to terrestrial. This part of the section is thinly interbedded shales to sandstones with numerous sub-bituminuous coal beds and abundant volcanics in the southern part.

The geology of this basin is poorly understood, largely as a result of difficult operating conditions. The region is almost entirely covered by dense rainforest, and there are few roads or trails. Most surface geological work has been restricted to the courses of the numerous streams which drain the region. Very little seismic work has been attempted. Only two wildcat wells have been drilled which indicated 20,000 ft or more of Tertiary to be present.

Western Cordillera. The Western Cordillera lies between the Pacific Basin and the Central Cordillera and is actually a late Cretaceous to Oligocene uplift along the eastern flank of the Western Geosyncline. It is comprised mostly of metamorphic sediments that are considered mostly as of Lower Mesozoic age. Igneous rocks include both extrusives and intrusives. This uplift is flanked by intermittent outcrops of Cretaceous black shales interbedded with abundant volcanics. There is no positive evidence that the Cretaceous seas extended east far enough to cross the Central Cordillera.

Atlantic Basin. The term Atlantic Basin is used for convenience to include the northern extension of the Western Geosyncline along the Atlantic Coast and the eastern lowlands along the trend between the Central Cordillera and the Santa Marta Mountains. There is a distinct difference in the geological conditions in the two parts of the basin, but these are better understood if considered jointly. The dividing line is along a so-called hinge line which follows along the projected western edge of the submerged northern extension of the Central Cordillera. Most of the area is flat to rolling open grassland with many large permanent swamps.

The area east of the hinge line appears to have been a crystalline rock land area until about mid-Oligocene, when it subsided and the seas transgressed easterly across it to the positive Santa Marta-Ocaña trend. Mid-Oligocene sediments rest on basement in this area and are essentially marine black shales. In places basal shoreline facies have been found of mixed sand and shell fragments ranging from sandy coquina to crystalline limestone. The entire section is locally more sandy along the eastern side and piedmont and delta deposits occur. Upper Oligocene and more sandy marine Miocene to Recent deposits also cover this area, the Miocene overlapping in the southeast corner to rest on igneous basement.

The structural conditions east of the hinge line are simple, consisting of broad gentle domes and anticlines, and stratagraphic overlap with minor thrusts and normal faults. The stratigraphic conditions seem to be more important than folded structure. Gas has been found by drilling folded structures within the basin, and commercial oil occurs along the eastern flank in basal calcareous horizons and basement.

(Continued on page B-29)

**After eight years,
the tempo is increasing**

Area of Promise

OIL EXPLORATION IN NORTHERN COLOMBIA

Encouraged by a new and favorable oil law, about 30 prospects and 70 geologically located wildcats have been drilled in the north coast area. Wildcats are being drilled or planned by seven companies

The North Coast Basin of Colombia embraces a large area becoming more active. Seven companies are drilling or planning exploratory wells in this area.

C. R. Goss
*Exploration Superintendent,
Richmond Petroleum Company,
Barranquilla, Colombia*

OIL INDUSTRY activity in northern Colombia is currently concentrated in the area from Barranquilla south to the Andes. Other areas in northern Colombia have had considerable exploration activity in the past, but are receiving little or no attention now. These were the Guajira peninsula and the César Valley where wells were drilled in the late forties and early fifties, mostly with negative results. These areas are geologically separate from the North Coast Basin and are excluded from this discussion.

The north coastal area of Colombia has been sporadically explored for oil since the early years of this century when attention was first attracted to the area by the many oil seeps. The first wells were drilled on or near these oil seeps, but none proved commercial. Surface geologic studies in the twenties along the outcrop zone on the west side of the basin resulted in the drilling of several tightly folded anticlines, still with negative results. Activity was dormant in the thirties, but was again intensified in the early forties after a modernized, improved petroleum law was enacted. This is the petroleum law that is currently in effect. Under the petroleum law, land is relatively easy to obtain and is available on a non-bid basis. The first-come-first-served pro-

Most seismic work in Colombia is transported by helicopters.

Helicopters do seismic work and geologic reconnaissance.

vision of the law has always been honored.

The new petroleum law stimulated activity and led to Shell's discovery of the Difícil field in 1942 after conducting gravity and seismic surveys. The name of this field (Spanish: Difícil — English: difficult) proved to be prophetic for further oil finding efforts in the basin. Socony discovered the Floresanto field in 1944 and after drilling 12 wells it proved to be non-commercial. Fifteen years after Shell's discovery, the second commercial oil field was found. Colombian Petroleum Company (Texas 50 percent — Mobil 50 percent) discovered their Cicuco field in 1956. Two dry gas fields have been discovered, Jobo by Texas and Socony in 1948 (now held by Intercol) and the Chinú field by Richmond in 1956; these have remained undeveloped pending development of local markets. Each gas field has one shut-in producer. About 30 prospects and 70 geologically located wildcats have been drilled to date in the basin which resulted in the two commercial oil discoveries. Most of the wells have had shows of oil or gas.

After relatively little activity during the last eight years, the rate of exploration is again increasing. Currently, there are seismic parties operating for Intercol, Colpet, Texas, Sun-Pure, and Richmond. One gravity party is being operated by J. W. Mecom. Geological parties are operating for Richmond, Intercol, Sun-Pure, and Cities Service. Wildcats are being drilled or planned by Texas, Colpet, Intercol, Sun-Pure, J. W. Mecom, Delta Colombian, and Richmond. Development drilling with one rig is being carried out by Colpet in their Cicuco field, where recently some 2000 to 3000 bbl of oil per day producers of 41 deg API oil have been completed. The field now has seven producers and no dry holes. Shell has done no drilling in their Difícil field in recent years. The field has 29 wells of which 18 are now producing about 1100 bbl per day of 42 deg API oil.

The Andian and Sagoc pipelines cross the basin from the interior, where they carry oil from the Middle Magdalena Basin fields and from the Barco fields on the Venezuelan border. The Difícil oil is batched into the Andian line and the Cicuco oil is carried by a short connecting line to the Sagoc line. The only refinery on the coast is located at Cartagena and has recently been inaugurated and put on stream by Intercol; this has 26,500 bbl per day capacity.

Geological Features

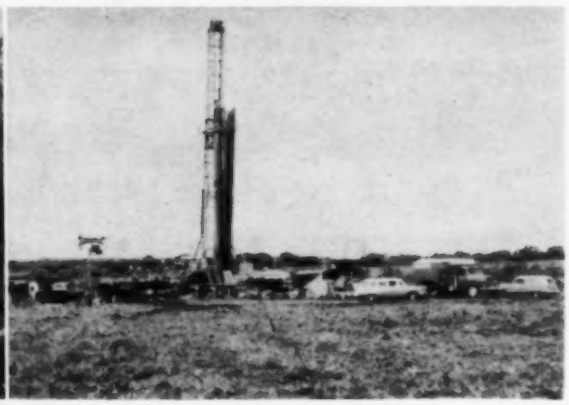
The North Coast Basin as a geological entity extends from the Barranquilla area on the north to the Andean foothills on the south and into Panamá on the southwest. The basin is filled with what is essentially a Tertiary sequence of rocks. There is an older group of Upper Cretaceous and Paleocene marine clastics, but these are highly deformed and little is known of them. Petters (1955) lists two fossil localities from this sequence of rocks that carry an Upper Cretaceous microfaunal suite and indicate shallow marine ecologic conditions.

Eocene sediments. The majority of sediments in the basin are Eocene and younger and are composed of a thick series of marine rocks. These rocks are exposed along the west side of the basin. An east dipping outcrop section

Rio Magdalena and surrounding area near Colpet's Cicuco field.

Typical river front and type of canoes used for transport.

Shot hole drill on seismic party in Department of Cordoba.



Wildcat well in Department of Cordoba.

on the road between Carmen and Zambrano is described by Petters and Sarmiento (1956). The section described consists of 5385 meters (17,668 ft) of Lower Oligocene to Middle Miocene marine shale and sands. There are still more up-section rocks other than those described, but of non-marine origin. Below the Lower Oligocene shale on this section lay a thick section of Upper Eocene marine sands inter-bedded with dark gray and chocolate-brown shales. Conglomerates and local build-ups of algal, reef limestones also occur. Although there are facies changes throughout the basin, the Carmen-Zambrano section represents the general type of rocks and the microfauna are rather complete assemblages which contain diagnostic types for the various geological ages.

Major fault boundary. The northeast side of the present-day basin is bounded by the major Santa Marta transcurrent fault. This fault places the igneous mass of the Santa Marta Mountains in contact with the Tertiary sediments of the basin. Another major transcurrent fault, the Oca, bounds the north side of the Santa Marta Mountains. These faults have been discussed in a recent article by Rod (1956).

The south basin area. The south and southeast side of the basin exhibit more stable tectonic conditions where the sediments have progressively onlapped the basement rocks. The Rio Cauca coincides approximately to the present-day sedimentary-igneous contact.

The west side. The west side of the basin from Barranquilla to Panamá is an area of intense folding and faulting. It is clearly the mobile side of the basin and has undergone several orogenies through the Tertiary. Clark and Durham (1946) describe the area west of Carmen as an area where the deposits are folded into a series of long parallel anticlines and synclines with some of the anticlines broken by strike faults. Mud volcanoes occur in several localities throughout the west side of the basin.

Geology not simple. The geology of the basin is not a simple, straight forward set of predictable stratigraphic and structural conditions. This is confirmed by the wildcatting and discovery record. However, the many manifestations of oil, both on the surface and in the subsurface give significant indication that this is a potential oil province of larger magnitude than the discoveries and drilling to date would indicate.

Factors Stimulating Exploration

The increased activity on the north coast is caused by several factors:

1. The government has expedited the processing of concession applications, so that more land is being converted into contract concessions. When an application is converted to a concession, it is to a company's advantage to evaluate the concession or a group of concessions, as a drilling obligation becomes mandatory on each concession after 4½ years.

2. The Colombian Petroleum Company's discovery of 41 deg API oil at their Cicuco field in 1956 proves that Shell's Difícil field was not an isolated, unique discovery but an indication that oil may be expected elsewhere.

3. A more favorable tax law was

Helicopter landing to pick up a portable seismic shot hole rig.

Surface geologic work in the outcrops of the Andes foothills.

The Author

C. R. Goss *is exploration superintendent for the northern division of Richmond Petroleum Company of Colombia. He attended the University of Washington and graduated in 1943 with a BS degree in geology. After three years in the Navy, he entered the University of California and in 1948 obtained an MA degree. He joined Richmond Exploration Company (Standard Oil Company of California) at Maracaibo in 1948 and in 1952 was transferred to Bogotá. Early in 1957 he went to Barranquilla where the northern division offices are located.*

decreed in 1955 and in 1956 became effective. This law greatly improves the tax structure under which the petroleum companies operate. Prior to this, the depletion allowance was limited to 10 percent and when all factors were taken into consideration, the profit split was about 40 to 60 in favor of the Colombian government. This was not intentional, but rather the nature of the cumbersome law.

The Colombian government recognized the need to stimulate the search for oil and enacted the new tax law. Under this law, the depletion allowance is 25 percent if $800,000 a year is spent on exploration. It was this provision that induced Colpet to drill the concession that resulted in the Cicuco discovery. Also, under the new law, the government receives not more than 50 percent or less than 40 percent as determined by a combination of royalty and taxes. The royalty decreases inland from tidewater. Another provision states that no patrimony tax be paid until exploitation begins. This far-sighted legislative action is continuing to bear fruit as more companies enter Colombia and increased exploration is underway.

Bibliography

1955 Petters, V. "Development of Upper Cretaceous Foraminiferal Faunas in Colombia," *Jour. of Paleontology*, Vol. 29, No. 2, pp. 212-225.

1956 Petters, V. and Sarmiento, R. "Oligocene and Lower Miocene Biostratigraphy of the Carmen-Zambrano Area, Colombia," *Micropaleontology*, Vol. 2, No. 1 pp. 7-35.

1946 Clark, Bruce L. and Durham, J. Wyatt "Eocene Faunas from the Department of Bolívar, Colombia," The Geological Society of America, Memoir 16.

1953 Redmond, C. D. "Miocene Foraminifera from the Tubaba Beds of Northern Colombia," *Jour. of Paleontology*, Vol. 27, No. 5, pp. 708-733.

1955 Burgl, H., Barrios, M. and Rostrom, S. M. "Micropaleontología y Estratigrafía de la Sección Arroyo Saco, Depto. del Atlantico," *Boletin Geologico*, Vol. III, No. 1, pp. 1-114.

1956 Rod, E. "Strike-Slip Faults of Northern Venezuela," American Association Petroleum Geologists Bull., Vol. 40, pp. 457-77.

★ ★ ★

Colombia's Geological Features — continued from page B-25

West of the hinge line, in what is frequently called the Sinu or Bolívar Basin, the Lower Tertiary and Upper Cretaceous also are present. The Cretaceous is not exposed very well, but it is comprised of marine black shales with minor cherts and limestones similar to the Upper Cretaceous of the Middle Magdalena Valley. The fossil content of the Cretaceous has been interpreted as an indication that the Cretaceous seas in this geosyncline did not connect with those of the Eastern Geosyncline.

The Paleocene in this area shows a marked change to coarser clastics, and in one well several thousand feet of conglomerates were encountered close to the hinge line. The Eocene is also coarsely clastic and contains numerous so-called lenticular reef-limestones. These are better called calcareous sandy shoreline deposits and range from crystalline limestone to sandy coquina to calcareous and pebbly sandstones. This shoreline facies disappears westerly but continues easterly rising in section to the Middle Oligocene. The Tertiary continues to be marine up section with shales predominant in the Oligocene.

West of the hinge line the structural conditions are those expectable in a compressed geosyncline. The structural grain is parallel to the hinge line, and dips are steep to overturned. The folds are complicated by an imbricate thrust pattern with displacement both to the east and west. There is a prominent angularity between the Eocene and older beds in places, particularly close to the hinge line, and along this same belt the Eocene contains huge angular blocks of igneous rocks that seemingly came from a nearby fault scarp.

Cordillera Central

The Cordillera Central is the old backbone of Colombia which formed part of a relatively narrow positive trend that curved around the northwestern flank of the Guayana Shield. The origin of this trend was pre-Cretaceous and hence beyond the scope of this discussion, but the author believes that it was a continuous barrier between the two Cretaceous geosynclines in Colombia and included the Central Cordillera, the Santa Marta Mountains, and the igneous hills in the Guajira. There are statements in the literature denying this continuity because of an east-west structural grain in the Santa Marta Mountains, but this same structural grain is also clearly present at intervals in the sediments all along the Atlantic Coast of Colombia and is clearly something that developed during the late Tertiary to Recent times. However, whether true or not, the acceptance of a continuous barrier makes a very practical and useful working hypothesis in the search for oil in Colombia.

The Cordillera is composed mostly of metamorphic and igneous rocks. Volcanoes form several of the high peaks, some of which are permanently snow covered, and, although some are still active at intervals, they were particularly active during the Miocene. The flanking sediments indicate that the area was low during the Cretaceous and a source of only fine clastics during that time, a source of coarser clastics and vari-colored muds during the Lower Tertiary, and of increasingly coarser clastics during the Miocene. The latter sediments contain pebbles of volcanic and crystalline rocks derived from the area of the present Cordillera.

Bibliography

1. Handbook of South American Geology, GSA Memoir 65, 1956.
2. Tertiary Fresh-Water Molluska of the Magdalena Embayment, Colombia, Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. LXXXVII, 1935, Pillsbury, Olsson, Wheeler.
3. Geology of the Barco Concession, Colombia, GSA Bulletin, Vol. 55, 1944, Notestein et al.
4. Habitat of Oil. AAPG, 1958.

★ ★ ★

Gauchos and helicopter symbolize the change in progress in Colombia. This whirleybird is part of a seismic party seeking to find the South American country's oil potential on the high plain of Sabana de Torres.

GEOPHYSICAL PARTIES —NO PICNIC IN COLOMBIA

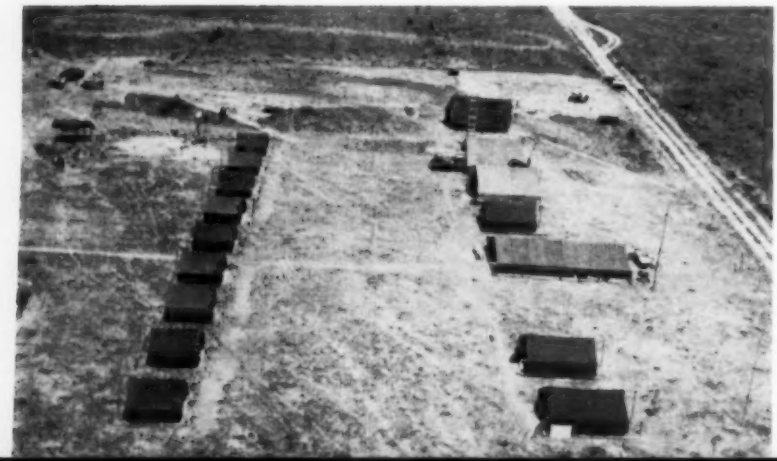
BARRANCABERMEJA, Puerto Wilches, Sabana de Torres — perhaps these will someday be the Longviews, Venturas, and Midlands of Colombia. To find out, geophysical parties are hacking their way from these towns into the jungles and across the plains. As yet, the oil potential is hardly touched and the extent is unknown. The fact that one Colombian field has an estimated reserve of one billion barrels, and the fact that the country lies not far from Venezuelan production, however, give impetus to the search. At present, there are nine seismic parties active in Colombia for six different oil companies.

A typical crew is that of Party 512, Geophysical Service, Inc., that has been punching shotholes into the rugged terrain for many months. Its equipment is both truck-mounted and portable, operating with three truck-mounted drills, four portable drills, three tractors, and two helicopters. The party consists of about 150 men.

Crew quarters may be a hotel in one of the Colombian cities, villas in a small town, or in isolated tent camps.

Party 512, as all seismic groups, does not linger long in one place. Mode of travel from location to location is varied. Transportation may take the form of helicopters over the jungle, narrow-gage rail from town to town, paddle-wheeler riverboat down the great Rio Magdalena, or by truck over bulldozed roads.

In Colombia, the seismic crews work almost continuously, and the usual work-shift is 24 days on duty followed by a seven-day rest leave. Length of the leave permits the doodlebuggers to make the most of their holiday. Some head for the warm resort hotels on the Caribbean; others go to Bogata, the capital city, in the mountains; some make frequent plane trips back to the



Home for the seismic crew is where the hat is — in this case, in tents in Colombia. Total crew complement is about 150 men.

U.S. On one occasion a group of Americans chartered a DC-4 to return to see a Texas football game and spend a weekend in Dallas. Most of the men are single and free to travel, although the married men bring their families to Colombia, lodging them in hotels or apartments in Bogata or the resort city of Barranquilla.

Field locations of the crew are for the most part isolated either by the dense jungle near Cimatarra or Puerto Wilches or on the plains of Sabana de Torres. Contact with the outside world is made by light plane or helicopter. Most fresh foods, meat, vegetables, and eggs are purchased locally. Canned goods, mostly made in the U.S., are delivered by helicopter or light plane daily from established oil company commissaries. Personnel make use of these facilities for leaving camp and returning from rest leave.

Daily production reports, orders, requests for parts, and general communication is made possible by the party's radio transmitter and two receivers.

Fuel for the motorized equipment, drilling supplies and new equipment must be brought up the Rio Magdalena by riverboat to Puerto Barreio, then transported overland to the party camp. On some locations, the crew is fortunate enough to have an air strip large enough to accommodate DC-3s for emergency equipment shipments.

Life with the party is never humdrum. Problems of the jungle, swamp, and plains operations are always present. Mud and denseness of the jungle growth always poses its breed of trouble. Party 512 recently experienced a serious helicopter accident while transporting a portable drill. The whirleybird was totally demolished when it crashed into a field of tree stumps; the pilot was badly cut and suffered a broken leg.

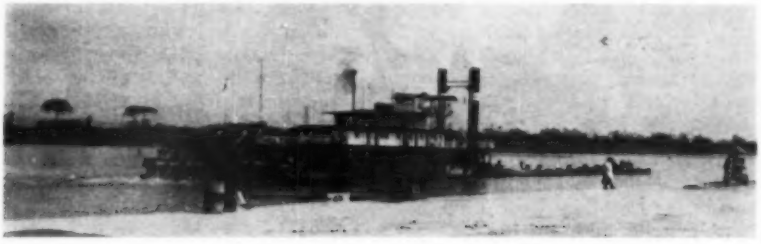
This portable drill is one of four that must be toted through the jungle day by day.

Equipment used in daily operations is handled by Colombian nationals, much of which must be carried on the back or in slings. No area is remaining uncharted by the group. Because the work is continuous, the data being accumulated for oil company files is fast becoming voluminous. The day when companies put this information to use in the form of exploration wells is fast approaching, thanks to the groundwork laid by the geophysical prospectors.

Acknowledgment

Photographs and much of the information contained herein were supplied by Geophysical Service, Inc. ★

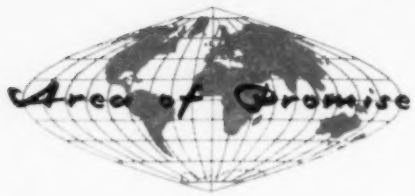
Grass shacks in the swampland country of Colombia provide local color for seismic operations. Doodlebuggers will attest, however, that the work isn't as easy as it is picturesque.



♦ **Riverboats on Rio Magdalena** play an important role in the transportation and communication scene in Colombia. Much of Party 512's equipment arrives in this fashion.

♦ **Party 512 is always on the move** — This time by rail from Puerto Wilches to Sabana de Torres.

Pilot program tests floodability of this Colombian field



Waterflooding Gets a Try at LA CIRA

Reservoir problems included high oil viscosity, discontinuous formations, weak, caving shales in the pay zone and wide variations in both porosity and permeability

Bigger than Texas, Colombia is Venezuela's neighbor to the west. La Cira field is in the De Mares Concession in north central Colombia.

Horacio Rodriguez,
Empresa Colombiana de Petroleos, Bogota, Colombia

PILOT WATERFLOOD operations were started in the 3-West area of La Cira field in northern Colombia in January 1957. Reservoir studies of the field showed some operational characteristics which could render any waterflooding program of the entire field a marginal situation. The high reservoir oil viscosity, lack of continuity of individual sand members, weak, caving clay shales within the pay zone and wide changes in both porosity and permeability suggested the need of a pilot-flood project which will determine the floodability of the La Cira field. Since this pilot-flood operation does not as yet, give any definite proof of the feasibility of waterflooding the field, this paper is intended to present a summary of the characteristics of the pilot-flood.

Location and Geology

The La Cira field, which forms a part of the De Mares Concession, lies in the eastern part of the Middle Magdalena Valley in the north-central part of Colombia (shown in reference map).

The La Cira structure is an elon-

Horacio Rodriguez *is a reservoir engineer for Empresa Colombiana de Petroleos (ECOPETROL) at Bogota, Colombia. He has held this posiiton since his graduation in 1957 from the Pennsylvania State University (USA) where he received his masters degree in petroleum engineering. Rodriguez also was graduated from the School of Mines in Medellin, Colombia, with a degree in geology and petroleum engineering.*

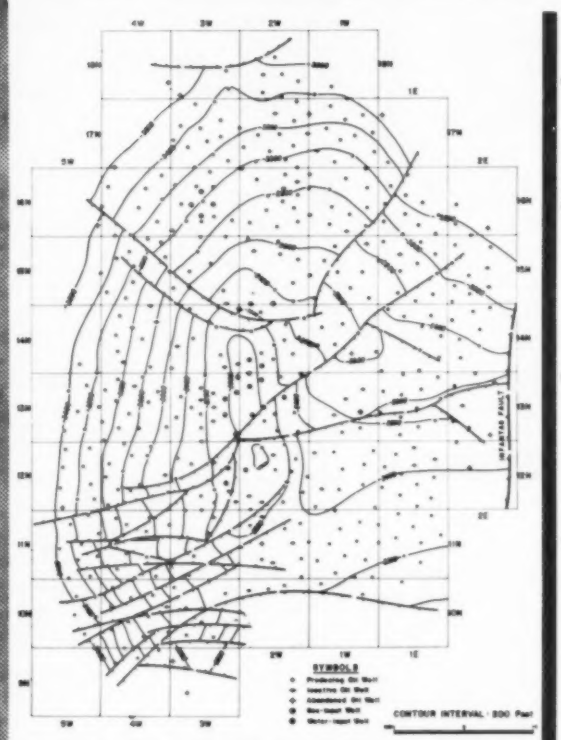


FIG. 1. **Structural map of La Cira field** indicates badly faulted condition. Two-hundred-foot contours drawn on top of the C-Zone, being tested for floodability in 16N, 3W.

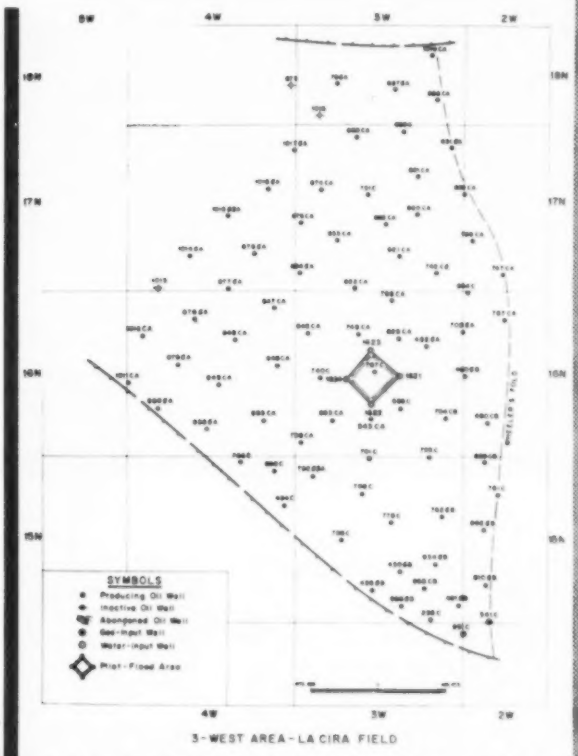


FIG. 2. **Pilot test** is being conducted in the 3-West area of the La Cira field. The five-spot pattern pilot flood is shown in 16N, 3W.

gated, faulted, assymmetrical anticline. Its major and minor axes are 5½ and 3½ miles long, respectively. The La Cira anticline illustrated in Fig. 1 shows the structural contours marking the top of the C-Zone. The eastern boundary of the field is formed by a northern extension of the Infantas fault. Dips over most of the structure vary from 5 to 12 deg, except locally along major fault planes. The proved productive area covers 12,625 acres.

The structure is broken just east of its major axis, by what has been named the "Wheeler's fold." This fold runs in a north-south direction and dies out in the southern part of the field. There are some steep-angled gravity faults which break the structure into a number of separate reservoirs. Most of these faults extend radially from the center of the field, and probably served to release the tension originated by the development of the major Infantas fault.

Production is obtained from loosely consolidated to unconsolidated Terciary sands (Eocene to Oligocene) which rest unconformably upon Cretaceous sediments. Three distinct zones, known from top to bottom as A, B and C-Zones, are responsible for the oil production. These sands are found at depths ranging from 200 to 4200 ft. The La Cira C-Zone consists of approximately 700 ft of interbedded sands and shales the individual sand members of which are lenticular and are separated by shale bands of varying thickness. Some of the sand members can be traced for considerable distance while others appear only in a few wells.

History and Development

Well No. 58, located in kilometer block 16N-3W, of Fig. 1, was responsible for the discovery of the La Cira field in April 1929. Tropical Oil Company, an International Petroleum Company owned enterprise, was in charge of the field operation and development until August 25, 1951. On that date, the De Mares Concession with all production, drilling equipment and improvements reverted to the ownership of the Colombian government. A new company, the Empresa Colombiana de Petroleos (ECOPETROL), was then organized to undertake the exploitation of the Concession.

The pilot-flood project is located in the 3-West area, a wedge shaped block located in the northwestern part of the La Cira field (Fig. 2). The first C-Zone production in the 3-West area was obtained in March 1929, then well No. 341 flowed 2840 bbl of oil. By 1939 the C-Zone was fully developed. At this time a total of 78 C-Zone wells had been drilled. The productive area, comprising 1512 acres, was developed on a spacing of approximately 16 acres per well. During the course of an extensive workover program conducted in 1950 and 1951, either the A or B-Zone was opened to production in many of the wells. At present, 72 percent of the wells are producing from more than one zone. Status of all wells is shown on the 3-West area map (Fig. 2). Cumulative oil production obtained from the C-Zone in this area to January 1, 1957, is estimated to be 33,566,900 bbl.

Gas injection in the 3-West area started in November 1947, when well No. 931 was converted into an injection

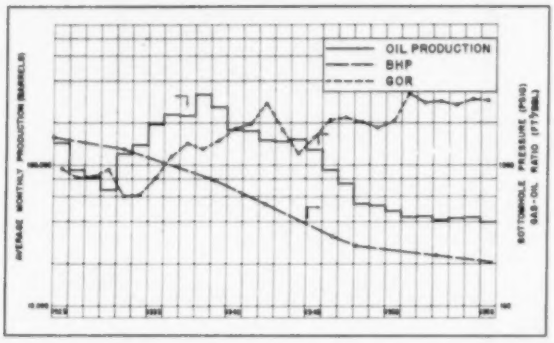


FIG. 3. **Pressure-production history** of the C-Zone in the 3-West area of La Cira field. Gas injection was started in November 1947, and had some apparent effect on BHP decline and production rate.

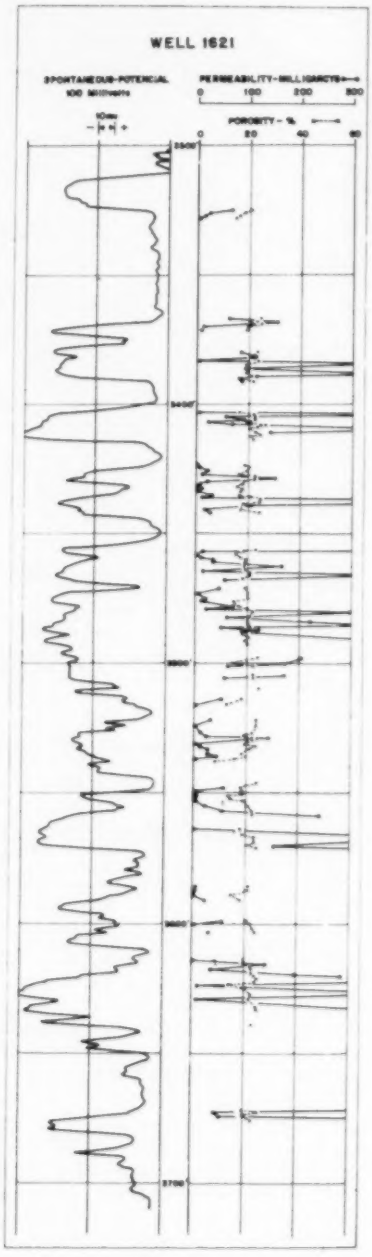


FIG. 4. **Composite electric log** of water input well No. 1621. Wide variations in both permeability and sand nature can be observed.

well. Two years later, well No. 341 started to inject gas and to January 1, 1957, a total of 4,474,000 Mcf of gas had been returned to the reservoir by these two wells. It is believed that gas injection has aided the oil production to a certain extent. Indeed, the oil production curve shown in Fig. 3 exhibits a decrease in the decline rate since gas injection was commenced.

RESERVOIR CHARACTERISTICS

The production history of the C-Zone in the 3-West area, as shown in Fig. 3, indicates that gas expansion has been responsible for the oil production. No free gas cap was originally present in the area. Although the water-oil contact has raised some 300 ft in the western side of the area, it can be said that no effective natural water drive exists in the reservoir.

First gas-oil ratio measurements indicate that the original reservoir pressure did not exceed the saturation pressure. Average porosity of the area has been estimated to be 23 percent. Porosity-permeability relationship indicates an average air premeability of 400 millidarcys. The reservoir temperature is 105 F. Present average gravity of the produced oil is 23.4 deg API.

A summary of the reservoir fluid characteristics is as follows:

Saturation pressure at 105 F	1570 psia
Oil compressibility at 105 F	0.58% /1000 psi
Oil viscosity at 105 F & 1570 psia	18.8 cp
Formation volume factor, initial	1.083
Gas solubility, initial	184 SCF/STB

Based upon volumetric and material-balance calculations, stock tank oil originally in place was found to be 290,000,000 bbl. Thus, C-Zone recovery in the 3-West area up to January 1, 1957, amounts to 11.6 percent.

Waterflooding Project

The former operator, Tropical Oil Company, conducted several experimental water injection projects in the field prior to its reversion to the government. Wells drilled on irregular spacing and completed with slotted liners were converted to injection wells. Water was injected without filtering or other treatment and leaks in the injection system, resulting from the corrosive nature of the injected water, caused the abandonment of the projects. Although the results were not conclusive, it was felt that water injection was of some benefit.

The low depletion of La Cira field by past and present production methods, suggested to ECOPETROL the possibility of waterflooding the entire field. Thus, on March 22, 1956, a contract was signed between ECOPETROL and Forest Colombian Corporation. Accordingly, Forest Colombian Corporation will undertake the waterflooding operations of La Cira field on a profit-share basis. It was further agreed that a pilot-flood, now in operation, was necessary to provide a definite answer on the floodability of the field. Although eventually the A, B and C-Zones are to be water flooded, initial operations are being devoted only to the C-Zone.

Due to the size of the field (8135 floodable acres), it was decided to divide the project into nine development stages. These individual areas will be developed yearly. Since most of the producing wells are completed with slotted liners through the entire C-Zone, injection wells will have to be drilled. About 10 percent of the new input wells will be cored in order to

provide presently lacking information on the reservoir. The input wells will be located as far as possible between the old producing wells. Resulting pattern will be five-spots averaging 16 acres.

Pilot-Flood Characteristics

Input wells No. 1621, 1622, 1623, and 1624, located in kilometer block 16N-3W of Fig. 2, were drilled to form the corners of a five-spot comprising some 13 acres. These wells were cored through the entire producing zones. Crude oil and brine were used as coring fluids in wells No. 1621 and 1622, respectively, and wells No. 1623 and 1624 were cored with conventional low water loss muds.

This coring program gave reliable information on the fluid content of the reservoir. Flood-pot tests, performed on many of the cores, determined residual oil saturation after water injection. The following table summarizes the oil recovery calculations for the pilot-flood area:

Porosity	23.0%
Water saturation	35.0%
Residual oil saturation, flood tests	25.3%
Initial oil content	1160 bbl/acre-ft
Ultimate primary recovery, est.	223 bbl/acre-ft
Residual oil after waterflooding	451 bbl/acre-ft
Secondary recovery oil	486 bbl/acre-ft
Secondary recovery oil, corrected for shrinkage, coverage and discontinuity	215 bbl/acre-ft

Fig. 4 presents a composite log of input well No. 1621. Wide variations in both permeability and sand nature can be observed.

Input wells were drilled to the bottom of the C-Zone. A 6⅝-in. OD casing was run and cemented at the top of the C-Zone and the wells were left full of salt water for more than a year while contract negotiations were being completed. Then well No. 1621 was completed with 4½-in. OD slotted liner through the entire C-Zone section. In wells No. 1622 and 1623, 4½-in. OD pipe was run, selectively slotted opposite the more permeable sections. Well No. 1624 was originally completed with a 4½-in. OD section of removable casing opposite the pay zone and steel casing protecting the more shaly zones. Deviation in the hole forced abandonment of the plan of removing the drillable casing section by under-reamer and the well had to be jet perforated by expendable guns. All four wells started to inject water on January 25, 1957.

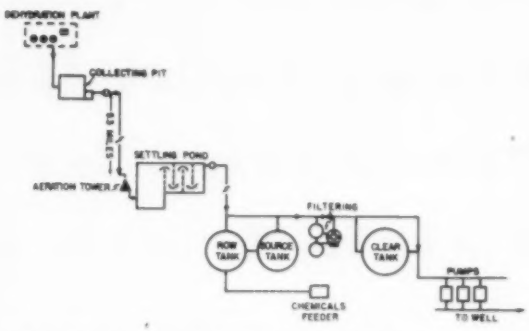


FIG. 5. **Water treatment and injection system** used on the pilot flood program in the 3-West area of La Cira field.

Injection System

Natural brine collected from the field dehydration plant has been used as injection fluid in the pilot-flood operations. Water supply exceeds by more than two-fold the present water injection requirements (some 2500 bbl-per day). It is evident that once waterflooding operations are expanded some other water source will have to be developed. Shallow wells proved the existence of fresh to brackish water beds throughout the field. Furthermore, nearby natural ponds and lakes could provide an all-year water supply.

Brine, coming from the dehydration plant, is received in a collecting pit where any oil present is removed by skimming. The water is then pumped to the injection plant through an asbestos-cement type pipe which was used to prevent leaks due to corrosion.

Water Treatment

At the plant, water is first passed through an aeration tower. This practice oxidized iron and manganese present in the water so that they can be settled or filtered out as oxidation products solids.

A settling reservoir receives the aerated water. This L-shaped basin, of some 13,000 bbl capacity, has a baffle distribution that greatly increases the settling time. Clay, sand and silt are thus practically removed from the raw water.

All water is filtered before being pumped to the wells. Filtering is done by a self-washing, pressure filter where the water passes through screens covered by asbestos and diatomaceous earth. Although only chlorine has been injected in the water, provisions are made to inject other chemicals if deemed necessary.

Three redwood tanks were erected at the plant for the storage of raw and clear water. A complete set of automatic electrical controls regulate the plant operations. Fig. 5 presents a schematic distribution flow diagram of the injection plant.

Results to Date

At this stage, the pilot-flood operations have not given any definite answer on the floodability of the C-Zone in the 3-West area. Hence, no attempt will be made as yet to compare the water flood calculated performance with factual data obtained. However, some operational problems encountered in this project have given valuable information regarding procedures advisable in future operations. For example, caving problems in the input wells have proved that open hole, or slotted liner completions of input wells must be avoided in the future. Instead, casing should be run and cemented through the entire C-Zone and the more permeable sands be opened by selective gun perforation.

Acknowledgment

The author appreciates the permission granted by the management of both ECOPETROL and Forest Oil Corporation to publish this article. Acknowledgment is also made to Karl L. VonderAhe, ECOPETROL, for his assistance in the preparation of this paper. ★ ★ ★

Colombia's fast Magdalena River threatened lucrative river drilling until . . .

River Installations Protected by Dutch Brush Mattresses

C. B. Roach
DeGolyer & MacNaughton
Dallas, Texas

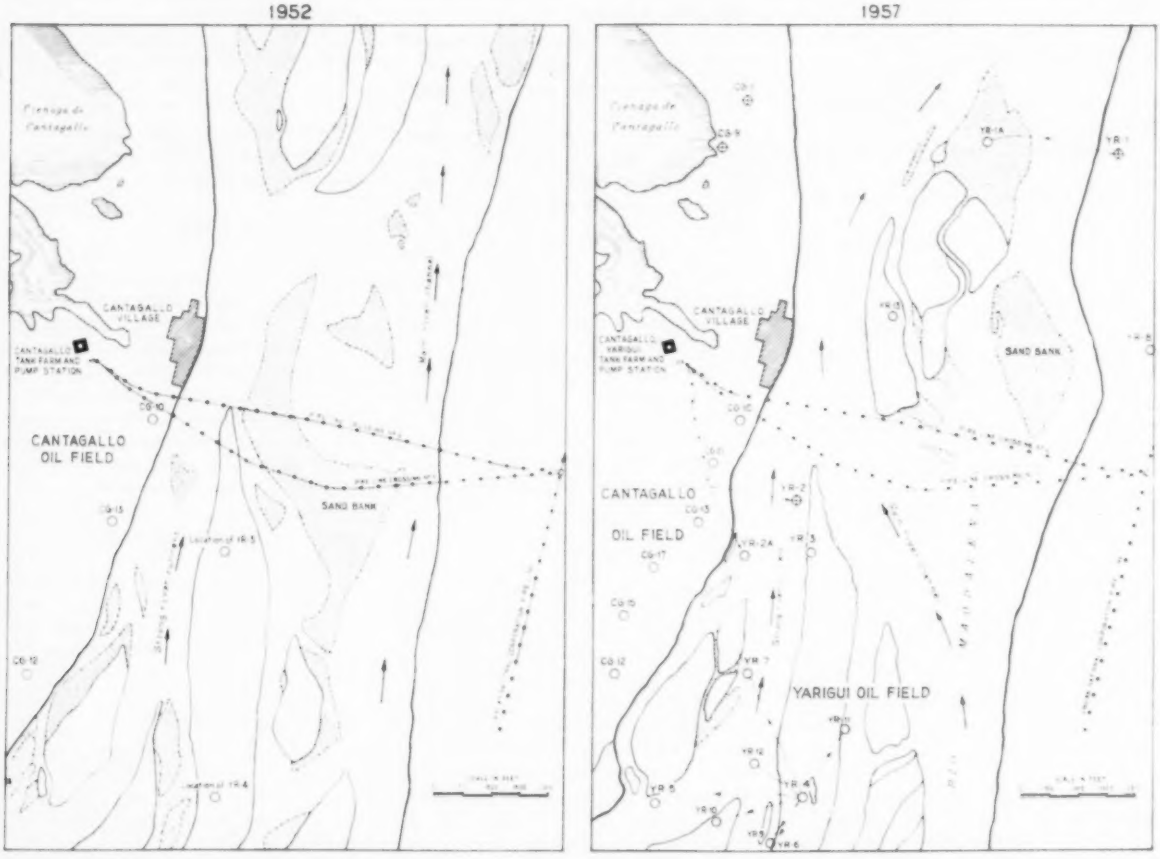
Centuries-old system stops slipping sand, saves Shell Condor's Yarigui field river project

DRILLING and producing oil from wells in river and flood area locations has always posed special well platform construction problems. In fields along the fast moving Magdalena River in Colombia the problem was solved, after other methods were abandoned in despair, by resorting *not* to a new method — but to a system used for centuries by the Dutch to hold back the sea. This method required that "mattresses" be woven from brush and tree saplings, then spread along the silty island banks and covered with rocks.

The Dutch system is working so well and is proving so economical and maintenance-free that new applications of the method are under consideration. This includes protection of port facilities and dyke protection in a second Colombian river-bounded field. Its usefulness, however, is not limited to Colombian fields, but to any river or flood-susceptible location of wells or well-storage facilities.

The Great Magdalena

In the Republic of Colombia the Magdalena River has been the princi-



—*Photos courtesy Shell Condor, S.A.*

FIG. 1. **In the middle of the Rio Magdalena** is the Yarigui oil field. The sand islands, on which the wells are located, shift constantly, as shown in this comparison of the river map in 1952 and in 1957.

FIG. 2. **Yariguí No. 3,** drilled in 1954 was temporarily protected from the fast river current by a pipe palisade. Note the washout behind the pilings.

pal thoroughfare for over 400 years and will continue to be so for many years to come.

It is not an old river meandering over flat plains, but a youngster driving with force between the eastern and central Cordilleras of the Andian mountain ranges. The river is given to extreme variations in current, depending on the seasons of the year, and because of this it is the despair of those who travel on it by boat in the dry seasons when the water is low, and of those who live on its banks and are subjected to its floods during the rains.

Not only is the Magdalena River the main route of transportation for central Colombia, but also for the oil fields which occur at certain points along its length. The greatest concentration of crude oil so far discovered in Colombia has been in this sedimentary valley in the vicinity of the refinery town of Barrancabermeja, some 500 miles from the northern sea port of Barranquilla where the river flows into the Caribbean Sea.

Along this river oilmen first moved in their equipment to explore and drill for oil, and to this day practically everything used in the oil business in this region travels the same route. And along its banks are laid the pipelines from which the crude oil produced from these fields is shipped to the coast for export.

Shell Condor, S. A. a subsidiary of the Royal Dutch/Shell Group, drilled its first exploratory wells close to the Magdalena River when it started drilling operations in Colombia in 1938, and success came in 1941 when the Casabe field was discovered opposite Barrancabermeja.

During the development of this field considerable knowledge was gleaned about the River Magdalena and its behavior, at an early date it was found necessary to build a dyke along one river bank to prevent the new oil field from being flooded during the wet seasons. A complex system of drainage canals was dug at the same time inside the field itself to take away the rain water. The Dutch system of building dykes and draining the land was therefore applied to the very first of Shell's oil fields in Colombia.

River Drilling

In 1953 Shell started outstep operations in what is now known as the Yariguí field, an extension of the old Cantagallo field lying entirely underneath the Magdalena River. The first wells were deviated from the river banks on both sides of the prospective oil field and were not very successful due mainly to difficulties connected with deviated drilling, but the presence

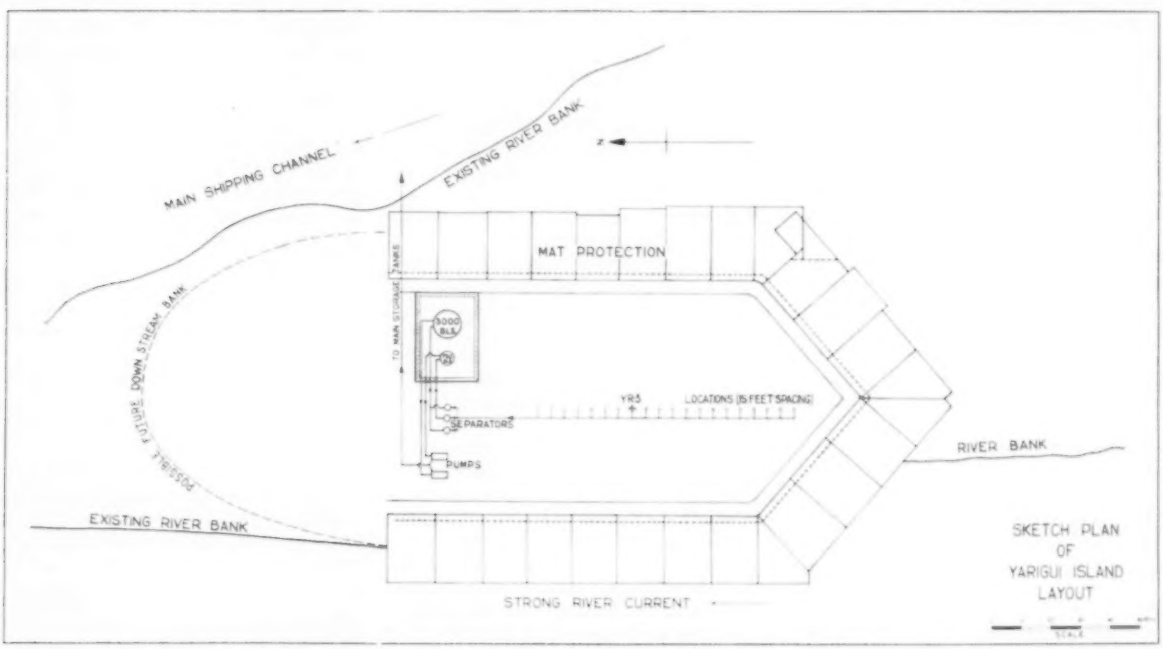


FIG. 3. **Mattress island,** as proposed in this sketch plan, was begun in January 1957. Well locations are spaced 15 ft apart and are deviated to locations for 25-acre spacing. The Yariguí field reservoir is at a depth of about 8200 ft. Horizontal displacements vary from 1000 to 3100 ft. Well No. 3 was drilled vertically.

of crude oil in commercial quantities was finally proved in February 1954 when Yariguí-2A, which was drilled and deviated from the west bank of the river, came into production making 2500 bbl per day.

With this encouraging result it was decided to drill Yariguí No. 3, a vertical outstep well on an island in the river, some 900 ft away from the bottom of Yariguí-2A. It was recognized from the first, however, that there would be the ever-present risk of the island being washed away by the river unless ways and means were adopted early to prevent this.

In this area the speed of the Magdalena varies from three knots in the dry season to as much as eight knots during the rains. Because it flows so fast, the river is always loaded with silt and carries a great deal of debris such as logs and trees; both deposition and erosion are rapid and innumerable islands and sandbanks are strung throughout its length. During the rainy seasons, which occur in May and again in October and November, all low lying country up and down the length of the Magdalena River, including the islands, becomes flooded and may stay so for weeks on end.

Effects of erosion are most pronounced at the beginning of each dry season when the water subsides; it is then that entire islands, several hundred yards in length, may disappear in a matter of weeks, carried away by the momentum of the water. Similarly, the river channel changes direction and new islands and sandbanks form at those places where the velocity of the water drops sufficiently to allow the sediment to fall out. Quite commonly small islands move downstream, as it were, intact, erosion taking place at the upstream end and deposition at the lower.

The map (Fig. 1) shows two topographical surveys made in 1952 and 1957, which very clearly illustrate the rapid changes that occur in the shape of the river in this particular area. There is usually one principal river channel, but not infrequently it may be split into two, or even three, each one separated by a multitude of islands. Depth of the water in the main channel may be as much as 33 ft at high flood, dropping to 23 ft and less during the dry seasons.

Width of the river bed varies considerably, although wider sections usually contain several islands. Such is the case at the Yariguí field where the narrowest part of the river facing the Cantagallo village is one mile across, and the widest part opposite the railroad town of Puerto Wilches is over 1¾ miles.

The Author

C. B. Roach, *prior to his present position with DeGolyer & MacNaughton, consulting geologists of Dallas, Texas, was for five years technical manager for Shell Condor, S. A., stationed in Bogota, Colombia. Roach is a native of London, England, and was graduated from the Royal School of Mines of London University in 1928. He joined the Royal Dutch Shell Group the same year as a petroleum engineer and worked in Mexico, the United States, Venezuela, and Colombia. He has just recently retired from Shell and taken on new duties with the Dallas firm.*

Erosion Noted

No sooner had rigging-up started on Yariguí No. 3 than the river began eroding the west bank of the island. (Fig. 2.) Several yards of river bank were lost in a week or so, and an attempt was made to correct this situation by driving in front of the well site a palisade or wall of old drill pipe and tubing.

This was supplemented by sandbags but the soft silty ground of which the island is composed was leached out continually from between the pipes by the swirling river water, and the engineers were ever on the alert to see that the situation did not worsen. An extension was made to the palisade later on to correct a tendency for the river to eat away further upstream and various types of makeshift packing and filling materials were thrown in behind this wall. A rock groyne also was added at one point which assisted to some extent in reducing the washing out.

Temporary Measures

It was recognized from the start that these precautions were purely temporary and that something more permanent would be necessary. As it happened, Yariguí-3 was a successful well coming in for 1800 bbl per day, and investigations and studies were made of the possible means of protecting it more permanently.

Consideration was given to the use of large diameter steel pipes which would be driven into the ground to a depth of about 300 ft and upon which a drilling platform could be constructed. This would allow the river to wash the island away without doing any harm to the drill site. However, this was not adopted principally because of the danger that the main river channel might eventually move across the well site and the platform would then become an obstacle to shipping and a dangerous hazard in case of collision.

An investigation was made of the possibility of using sheet steel piling, but this was turned down for a number of reasons, among them the difficulty of driving piles of this type through the variety of fine and coarse sediments below the bed of the river and of ensuring a thoroughly solid wall against the attack of the river.

Old Dutch System

Eventually it was decided to try out an old system of protecting earth works against water, developed by the Dutch many centuries ago for the building of their dykes. This consists basically of weaving a mattress of saplings and reeds which is laid over the place to be protected and then covered with rocks. In this case they would be laid continuously on the banks of the island in the form of a revetment, the principal being that the rocks which bear the brunt of the attack from the river, are held in place by the underlying wooden mattresses.

First, however, an investigation had to be made of the sources of supply of the raw materials, from which it was ascertained that reeds, saplings, and lianas for this purpose were available in unlimited quantities not far from the Yariguí field in the thick jungle which lines the River Magdalena.

The question of the rock was not so simple, but a suitable limestone quarry was found some 60 miles downstream with good access to the river, from which it was possible to carry the rock to the worksite by tugboat and barge.

Drilling Program

An important step in planning the Dutch mat work for these well sites was to decide on the area to be pro-

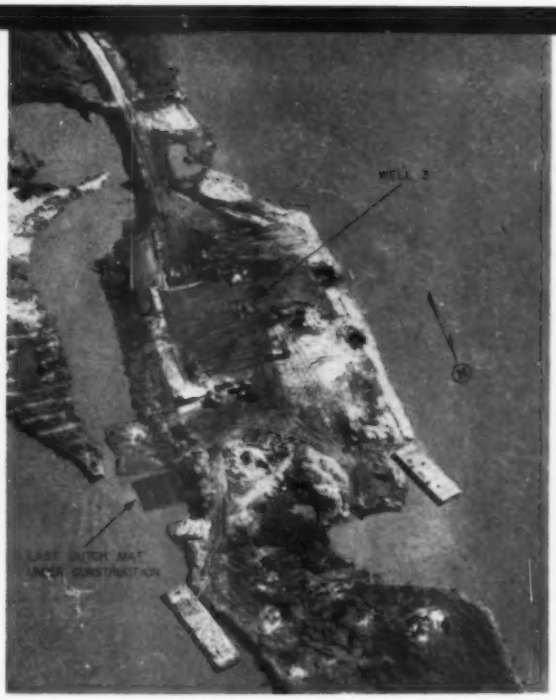


FIG. 4. **This aerial view** of the island protection work was taken in September 1957. It shows site of Yariguí No. 3 and the last Dutch mat ready for loading with riprap.

COLOMBIA

FIG. 5. **Construction** is just beginning on the first Dutch Mat in a borrow pit. Note stern-wheel steamer in background, a typical form of transportation on the Magdalena River.

tected. It is expected that up to 20 wells will be drilled at each island platform, of which all, except the first one, will be deviated in accordance with the 25-acre drainage pattern adopted for this field. After Yariguí-3 was completed the rig was moved 4000 ft to the south on the same island and Yariguí-4 was drilled vertically. This, too, was a good producer. Since then another seven wells have been deviated from this location.

The horizontal displacements vary from 1000 to 3100 ft, vertical depth of the wells being approximately 8200 ft. Drilling is at present carried out with an 800 hp, 8000 to 12,000 ft capacity rig, equipped with a 14 ft sub-structure, and it is skidded a distance of 15 ft between well heads. The wells are all in a straight line, and a house made of heavy structural steel has been erected over the completed Christmas trees to protect them from possible damage during subsequent drilling.

Of those wells completed so far in the Yariguí field all but one are flowing. Wellhead pressures and gas oil ratios are not very high and a test will be made shortly on the possibility of increasing production by gas lift.

Provisional well gaging facilities are now in use at well No. 4 from which the crude oil is pumped to the temporary main storage facilities at Cantagallo. Well No. 3 is at present flowing direct to the same tank battery, but it is planned later to set up permanent separator and tank stations at each island site and to pump the oil through a system of gathering lines crossing the bed of the river to main storage tanks on the east bank. With these ideas in mind the size and shape of the islands has been designed accordingly.

The sketch (Fig. 3) plan shows the proposed set-up at Yariguí-3 and also the layout of the Dutch mat revetment, which will be more or less a standard arrangement for the other island platforms. The protected area is rectangular with a triangular extension at the upstream end to ward off part of the force of the river and trees and logs coming down the river. Width of the platform is 230 ft and length from the pointed upstream end to the downstream edge is 500 ft.

Mat Construction

As a preliminary step before the first well is drilled at any island site, a 6-foot fill has to be made to raise the platform well above high flood level; this work is done with draglines and bulldozers. Because of the silty nature of the soil, water always seeps into the borrow pit at the edge of the fill and automatically assumes the same level as the river outside the island. When the time comes to start constructing the revetment, that is, when changes in the river show that this work must be carried out to secure the well site, the borrow pit is cleaned out to a depth of some 20 ft below high flood level and the bank from the top of the platform is carefully graded to a 2½ to 1 slope, corresponding to the natural underwater slope of river banks in this area. It is then smoothed off with hand shovels. By this time a stock pile of raw materials has been accumulated to start the actual construction of the mats.

A rectangular framework is laid out on the sloping bank consisting of thick lianas obtained from the jungle. A layer of reeds is then placed on this frame, followed by bundles or fascines of thin saplings and withies laid parallel to the top of the bank and also at right angles. A top framework of lianas is then placed over the whole mattress and the top and bottom frameworks are tied securely together with light rope.

At this point in the construction the mat measures roughly 50 ft wide, that is, parallel to the river bank, and 35 ft down the slope at right angles. This section is then pushed down until it is floating entirely on the water in the borrow pit, and another 35 ft or so is added on the sloping bank and fixed in place by means of wooden stakes. The size of the mattress is then roughly 50 ft by 70 ft and 18-in. thick but the area can be changed according to the conditions at the place where the mat is required.

A series of low hurdles or fences woven from saplings and about 18-in. high is strongly pegged into the entire mattress from one side to the other; these fences are spaced about three feet apart. The mattress is then ready to be loaded by hand with rock or riprap, first on the floating part until it sinks and rests smoothly on the submerged part of the sloping bank and the bottom of the borrow pit, and then on the dry part of the mattress above water level.

Rocks used for this purpose are roughly cut just as they arrive from the quarry and weigh in the neighborhood of 50 to 100 lb each. About half a ton of riprap is used per square yard

COLOMBIA

FIG. 6. **This barge with hand winches** is anchored in a main channel of the Magdalena River to haul mats onto the surface of the water.

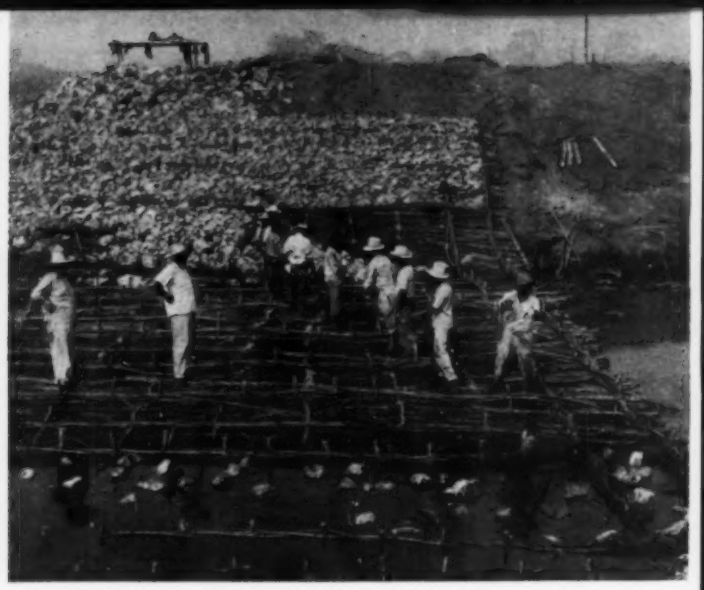


FIG. 7. **Sinking of the Dutch mat,** following its placement by the barge, is accomplished by loading it with riprap.

so as to form a layer about 18-in. thick, this gives the entire revetment a total thickness of three feet.

Construction Begun

The first mattress contructed in this way was started in January 1957 and laid on the northeast corner of the projected island for Yariguí-3, as shown in Fig. 3. This entailed a period of training for the workmen and also of experiment and trial for the engineers.

Such problems as presented themselves were quickly worked out and additional mattresses were laid side by side at the rate of one per week until the west side of the island was reached where the river had already encroached so far that there was no longer any room to make a borrow pit. On this side, therefore, the river bank was smoothed off as before, but as the mattresses were constructed they were pulled on to the surface of the river by means of winches on a barge anchored in the river. At the same time each mattress, as it floated out, was held in place by a system of guy ropes tied to the upstream side until the layer of rock had been deposited and the mat securely grounded on the river bottom.

Flexibility

An important characteristic of these mattresses is their flexibility, which allows them to adjust themselves readily to any irregularities in the river bank or to any wash-outs which may take place. It is not necessary, for example, to clean out the bottom of the borrow pit to the maximum depth of the river, which may be some 10 ft deeper in the main channels.

When the river eventually washes against this part of the revetment the mattresses sink as the silt washes away and thereby adjust themselves automatically to the deeper river bank. In this regard the length of the mattresses is such that they will eventually cover the entire river bank down to the maximum possible depth of any channel that may form there.

Mat Life

From experience in the Netherlands it is expected that these mats will last indefinitely, provided the wooden part does not dry out. In the case of the Yariguí revetments this factor is taken care of by covering the entire mat with silt so that it packs into the woodwork and in between the rocks. On the part above water grass and bushes soon start growing in the tropical climate and form a protective covering from the strong sun.

At the shoulder of the sloping bank just above the top of the line of mattresses, that is between the top of the platform and maximum high water, the ground is covered with asphalt which not only helps to prevent the moisture from drying out the ground but also stops erosion by rain water.

Advantages

Apart from the fundamental reasons for making Dutch mats, there are several other important advantages to their use in this area. First, materials required are readily available locally and are very cheap compared with sheet steel and other types of piling. Second, no special machinery is required and unskilled workmen can be employed using shovels, sledgehammers, and machetes. These men have been brought up in the jungle and use techniques in building their own palm roofed houses which are readily adaptable to the building of the mattresses. A certain amount of heavy machinery is, of course, necessary to build the island up above flood level and to shape it.

An added advantage of the system is the ease with which repairs can be carried out. Should, for any reason, a minor washout occur, then it can be stopped up by throwing in additional rocks, or alternatively, one or more additional mats can be built, floated into place over the damaged part, and sunk with rocks in the usual way. It is not anticipated that much maintenance will be required, however.

A fourth advantage of this system is that the mats need only be constructed at those points which are being threatened by the river; if the other sides of the island platforms are not in danger, completion of the rest of the protection work may be postponed until such time as it is required.

Other Applications Proposed

Use of this system, of course, is not restricted to protection of island well sites, but may be applied wherever river bank erosion is taking place and threatening installations such as port facilities and the dyke system at the Casabe field.

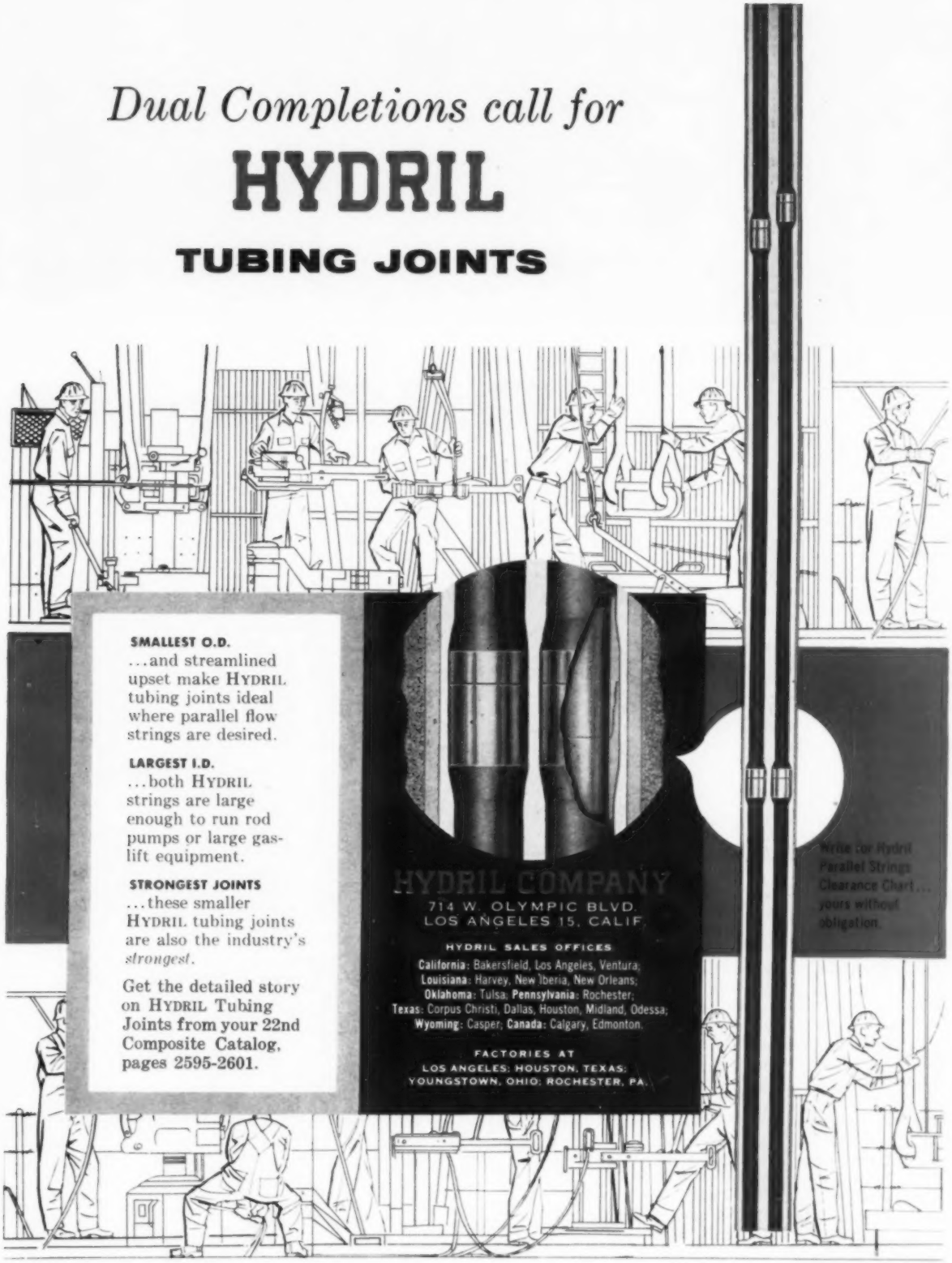
So far the first island platform at Yariguí-3 has been completely protected with 26 mattresses, representing about six and a half months work. Yariguí-4, the second platform, is at the present time safe from erosion and will be protected if and when the need arises.

The island where Yariguí-13 is to be drilled has only been in existence a relatively short time, and apart from being soft and unconsolidated, lies at a part of the river where considerable changes have taken place recently. It is planned, therefore, to start protecting this latter drilling site immediately. ★

Dual Completions call for

HYDRIL

TUBING JOINTS



SMALLEST O.D.
...and streamlined upset make HYDRIL tubing joints ideal where parallel flow strings are desired.

LARGEST I.D.
...both HYDRIL strings are large enough to run rod pumps or large gas-lift equipment.

STRONGEST JOINTS
...these smaller HYDRIL tubing joints are also the industry's *strongest*.

Get the detailed story on HYDRIL Tubing Joints from your 22nd Composite Catalog, pages 2595-2601.

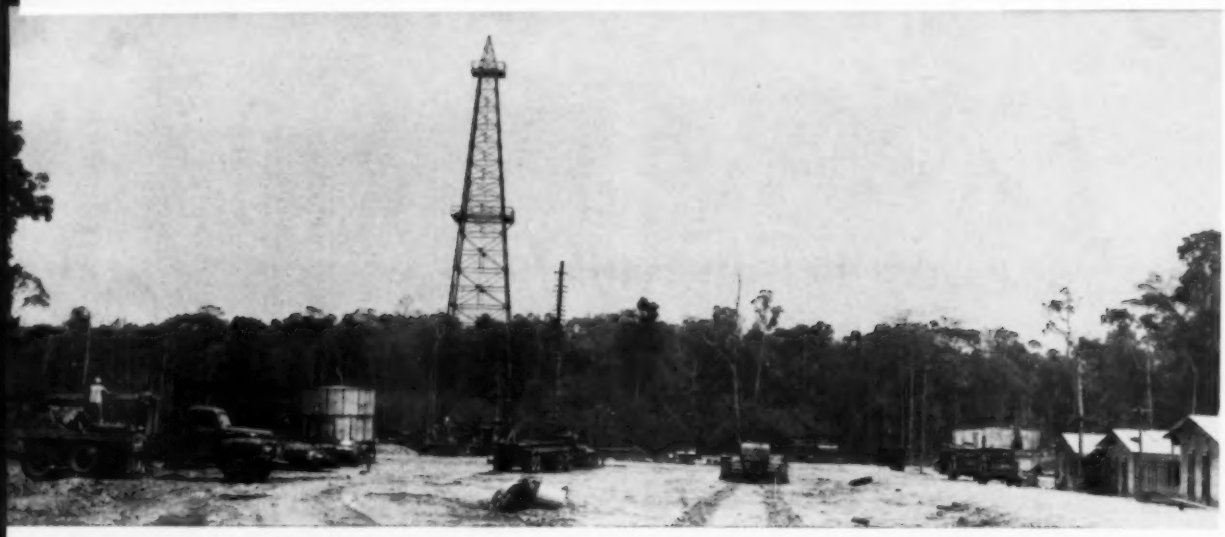
HYDRIL COMPANY
714 W. OLYMPIC BLVD.
LOS ANGELES 15, CALIF.

HYDRIL SALES OFFICES
California: Bakersfield, Los Angeles, Ventura;
Louisiana: Harvey, New Iberia, New Orleans;
Oklahoma: Tulsa; **Pennsylvania:** Rochester;
Texas: Corpus Christi, Dallas, Houston, Midland, Odessa;
Wyoming: Casper; **Canada:** Calgary, Edmonton.

FACTORIES AT
LOS ANGELES; HOUSTON, TEXAS;
YOUNGSTOWN, OHIO; ROCHESTER, PA.

Write for Hydril Parallel Strings Clearance Chart... yours without obligation.

DRILL PIPE...CASING...OR TUBING...YOUR BEST CONNECTION IS HYDRIL



Loffland Bros. drilling camp on location for Colpet near Puerto Wilches, on the Magdalena River north of Barrancabermeja.

Drilling in

Four drilling contractors are now working with 8 rigs out of the 40-45 now in the country

FOUR DRILLING contractors are now working in Colombia — An-Son Drilling Company, Loffland Bros., Santa Fe Drilling Company, and Drilling and Exploration.

An-Son Drilling Company

An-Son has a 125,000-acre concession held 50-50 with Hershey Oil Company, both of Oklahoma City. One successful well has been drilled at Lebrija, in the Middle Magdalena Valley near Totumal field of International. The 200-bbl-a-day production is sold to Ecopetrol's refinery at Barrancabermeja.

The company has three rigs in Colombia and is planning a fourth. C. L. Pitts is local manager. At present An-Son has an Ideco H-40 drilling for Richmond Petroleum Company (Standard of California); a Cardwell O drilling for Colombian Cities Service; and a Cardwell J-450 drilling for Texaco.

Carl Anderson said the company had a labor contract for another rig leased by Ambassador Oil Corporation, Fort Worth. This is the firm that took over the 40,000-acre concession in the Sinu Basin from Dr. Victor Oppenheim, who retains an overriding interest.

Like Louisiana, most drilling sites are marshlands. Anderson says they not only mount the rig on trailers, but also mount nearly all equipment, including fuel and water tanks. He says 18-ft speed boats with 40-hp motors are the means of transportation. An-Son expects to get a barge rig like those used in South Louisiana to Colombia for shallow water drilling.

PHOTO ON THIS PAGE COURTESY LOFFLAND BROS. COMPANY

Loffland Bros.

Loffland Bros. began operations in Colombia in 1951. C. F. Richardson directs operations from the headquarters at Cartagena. A radio system links the rigs with the headquarters, providing efficient contact and coordination of operations of the three rigs in the country.

Latest addition to the Loffland equipment in Colombia is a Mid-Continent U-20 rig and compound, with VT-12 Cummins engines and Emsco pumps. It is contracted to work for Sun Oil Company.

Besides this rig Loffland has two more — one Emsco J 1250, drilling for Texas Petroleum, and one National 100, drilling for Colombian Petroleum. All three Loffland rigs have capacity for deep drilling.

An unusual operation of Loffland concerns the rig "hopping", whereby it maintains two derricks and one string of tools. Drawworks, etc. are moved to one derrick and the well is drilled. While this is being done, crews are tearing down the derrick and reassembling it at a new location. By this time, crews have finished the drilling cycle and move back to the first derrick and the operation is repeated without interruption.

Santa Fe Drilling Company

Santa Fe has one rig, No. 30, in Colombia, a National 55 diesel, drilling for Texas Petroleum on the Corcovado Concession.

The subsidiary of the U. S. firm has headquarters at Carrera 10, 16-18 4° Piso, Bogota. Stewart M. Collester is manager and Homer Stout superintendent. Cable address is SFEDRLCO and telephone is 430-990.

Drilling and Exploration

Drilexco has one rig for contract drilling in Colombia. It is now operating for Mobil of Colombia in the Sinu Basin. An Oilwell 96, it has 15-16,000-ft capacity. Robey D. Deem is manager and E. J. Scroggins, superintendent. Headquarters are at Cartagena. Cable address is DRILEXCO; mail address, Apartado Aereo 1221.

Decree for Contractors

Recently the government passed a new decree providing that oil industry contractors pay their workers the same wage scale and benefits as the oil companies.

One drilling contractor said, however, "Oil companies recognize that we must pay a wage like the general level of wages in an industry whether brought about by government decree or independent action."

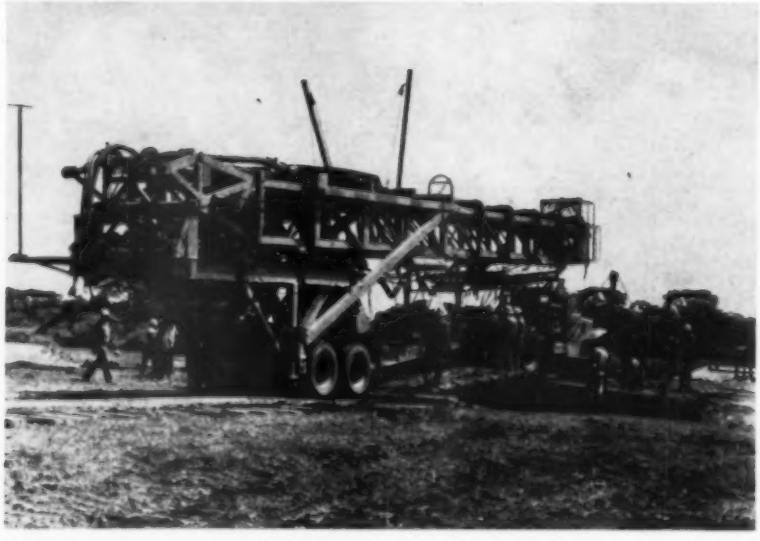
As a result oil companies adjust contract prices to balance wage payments.

Drilling by contract is a comparatively new business in Colombia, but from all indications, it is a growing one.

Waterways are the highways of Colombia drilling — all equipment is on trailers and/or barges

Many drilling operations in Colombia are similar to those in South Louisiana as shown in these photos at the site of Richmond's Ayapel No. 1.

Colombia



These photos show a location of Richmond Petroleum Company of Colombia on the San Jorge River in the North Coast Basin.

Excellent view of camp and location at Ayapel-1 located near bend of San Jorge River is shown above. In this photo the equipment is being loaded out for the move to a new location.

Note how water appears all around the location where the surface crust has been cut by equipment travel. White spots in the foreground are cattle.

In center is the derrick trailer as it starts off the barge for location. Wells are located as close to the river as possible to alleviate the loading and unloading problems in the muddy terrain. Extreme fluctuations in river water level sometimes causes difficulties in getting on and off the barges.

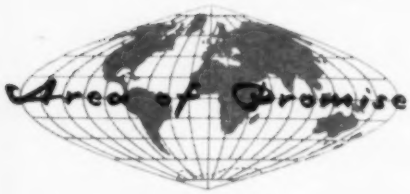
Loading out operations at Ayapel No. 1 are shown in bottom photo. In the lower right hand corner of the picture is the barge containing crew's living quarters. In the center of the picture is the tug boat used to move the barges. Two dugout canoes used to transport native personnel are tied up alongside.

Left of the tug is a barge loaded with mud, cement, fuel oil, casing, tubing, and presently receiving drill pipe. The next barge contains fuel oil, mud logging trailer, dog house, Schlumberger truck, Howco units, and miscellaneous equipment. Still to go on this barge are the drawworks, main and auxiliary mud pumps, fuel tank and compressor trailer, and mud tanks.

Notice the extreme muddy condition of location where equipment has gone over it. ★ ★ ★

PHOTOS ON THIS PAGE COURTESY RICHMOND PETROLEUM COMPANY OF COLOMBIA

First Installation In Colombia



Hydraulic System Solves Galan Pumping Problems

Seventeen directionally-drilled wells beneath a river and producing 19 gravity plus a lot of sand caused a pumping headache

William A. Gaviria
Empresa Colombiana de Petroleos
Bogota, Colombia

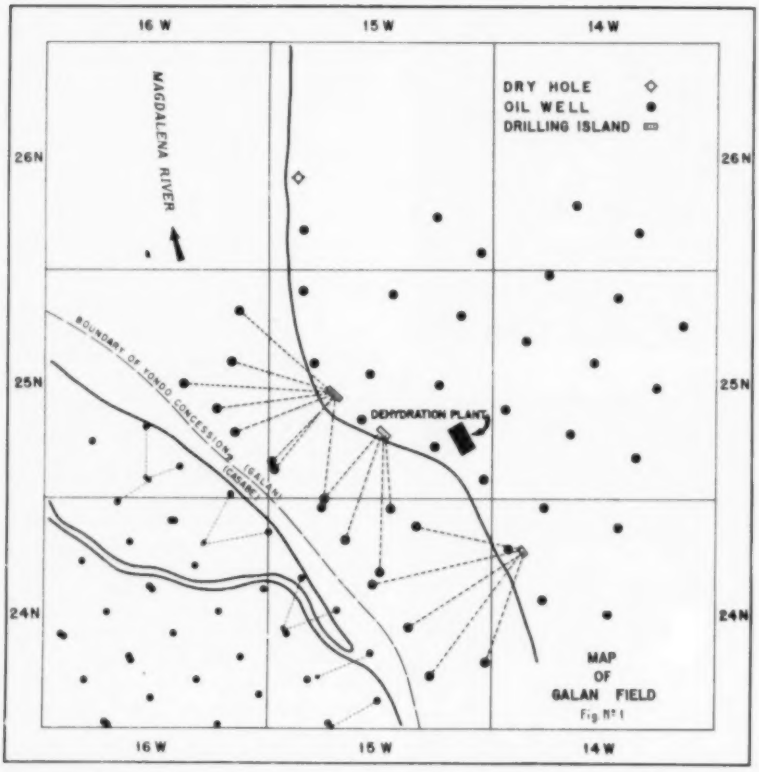


FIG. 1. **The Galan field in northern Colombia** showing well locations and directionally-drilled wells under the Magdalena River from three islands built up of the low shores of the river.

THE FIRST INSTALLATION of a subsurface hydraulic pumping system in Colombia solved a difficult production problem involving excessive sand production, deviated wells and a relatively low API gravity crude. Of the 45 producing wells in the Galan field of northern Colombia, 17 of them are bottomed beneath the Magdalena River which cuts through a part of the field. Cumulative oil production for the entire field to September 30, 1957, was 3.6 million bbl; of this amount, 1 million has been produced from the 17 directionally drilled wells which originally flowed.

The hydraulic pumping system was installed in these 17 inclined wells over a year ago, and was used to lift 450,000 bbl of the 1 million cumulative production from these wells. The heavy crude, with a 19 deg API gravity, was a major factor in reducing the overall volumetric efficiency of the system in all 17 wells to an average of 53 percent, but this is being improved. While sand production is still troublesome, the new system has reduced considerably previous pumping problems.

Location and Geology

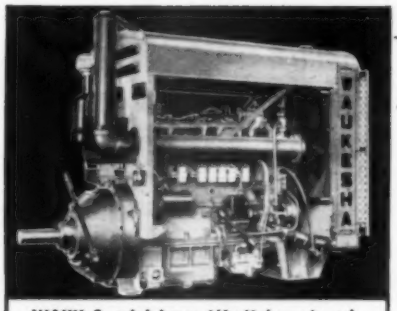
The Galan field is located about five miles northwest of the city of Barrancabermeja in Santander. It covers an area of approximately 13 sq miles including that portion beneath the Magdalena River. The terrain has little relief with no outstanding physiographic features other than swampy areas with sparse vegetation. Galan field is on the east side of the river and is actually the northeast extension of Shell Condor's Casabe field, on the opposite side of the river, which was discovered in 1941.

The Casabe-Galan structure trends northeast-southwest and is bounded on the northwest by a major, normal type fault which branches into a series of minor faults dividing the field into various blocks of limited extent.

'round and 'round the clock

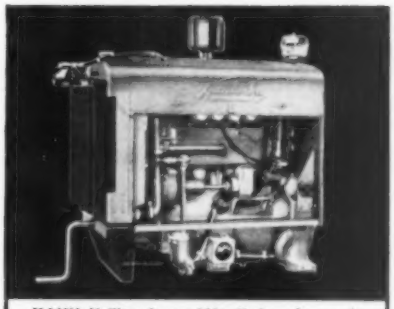
WAUKESHA

LONG LIFE OIL FIELD POWER UNITS



WAKU Special Long Life Unit—six cyl., 6¼-in. bore x 6½-in. stroke, 1197 cu. in., 125 continuous (65%) hp at 1200 rpm.

Features and accessories built into these special gas units enable them to operate without maintenance except at greatly extended intervals. Make big savings in pumping; compressor service; and feeder operations.



XAHU Utility Long Life Unit—four cyl., 3⅝-in. bore x 4½-in. stroke, 186 cu. in., 21 continuous (65%) hp at 1500 rpm.

Sizes range from 133 to 1197 cu. in.—14 hp at 1500 to 124 hp at 1200 rpm continuous duty ratings (65% of max. hp). For details get Bulletin 1702.

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN • New York • Tulsa • Los Angeles

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Typical island station built up on the low lands with one well being cleaned out by a portable pulling unit at right.

The stratigraphy corresponds to a development of non-marine sands and shales of Oligocene age which vary greatly in thickness. The productive sands are grouped between certain markers and classified as Zone A and Zone B following the system used in other fields of the De Mares Concession. Sands of the "C" Zone are not productive in Galan.

Table 1 shows the approximate vertical boundaries of these zones, the variation depending upon the structural location.

TABLE 1.

Zone	Depth to top		Depth to bottom		Net sand thickness	
	Min	Max	Min	Max	Min	Max
A-1	2522 ft	3372 ft	3188 ft	3946 ft	38 ft	241 ft
A-2	3209	3727	3495	3835	25	185
B	4474	5344	4837	5700	91	111

The total net sands producing in each Galan well vary in thickness from 38 to 346 ft.

FIELD DEVELOPMENT

The first well in the Galan field was completed in August 1945 by Tropical Oil Company, a subsidiary of International Petroleum Company. The company completed four more producing wells and drilled one dry hole by the middle of 1946. Four of the wells were completed flowing 110 to 400 bbl per day through ¼-in. chokes. The other was completed on the pump for 48 bbl per day. These five wells have produced a total to date (September 30, 1957) of 719,629 bbl.

After the De Mares Concession reverted back to the government in 1951, a company, the Empresa Colombiana de Petroleos (ECOPETROL), was organized to carry on the operations. In 1953, this company drilled eight more wells, all on the east side of the river. Then from September 1955 to March 1956, 28 more wells were drilled, 17 of which were drilled directionally from three islands on shore to tap that part of the field underlying the Magdalena River (Fig. 1). These wells were drilled vertically to 600 ft and then directed, building up their vertical angles 3 deg per 100 ft until the required angle of 25 deg to 40 deg was reached. These angles were held to within 200 or 300 ft of their objectives where the angles were permitted to decrease 4 deg to 12 deg (Fig. 2).

In 1957 four additional vertical wells were drilled extending the productive area to the east.

The rectangular spacing is about 26 acres per well for those drilled vertically and 13 acres per well for those directionally drilled.

The completion practice was to cement 6⅝-in., 20 and 24-lb J-55 and N-80 casing on bottom with enough cement to fill to 200 or 300 ft above the top of the A-1 Zone. Casing was then gun perforated with one hole per foot opposite sands selected by means of electric logs.

Many of the wells were completed flowing at rates of 60 to more than 400 bbl per day through chokes of ¾, ½ or ¼-in. which were changed as advisable to obtain the lowest gas-oil ratio and conserve reservoir energy.

The accumulated oil production of the Galan field to September 30, 1957, is 3,600,000 bbl of which approximately 1,000,000 bbl have been produced by the directionally drilled wells. Of this, 450,000 bbl have been produced in the last year from wells equipped for hydraulic pumping.

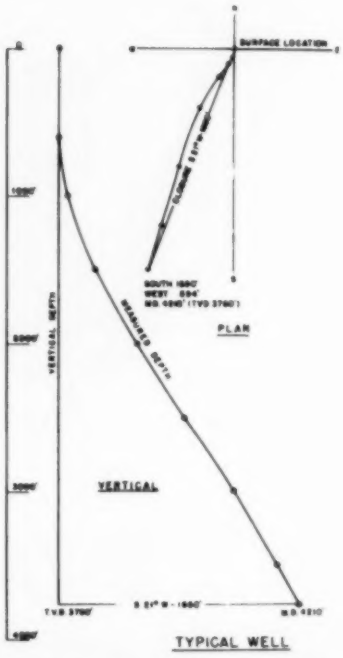


FIG. 2. **Average deviation curve** for a typical directionally-drilled well beneath the river, showing both vertical and plan locations.

Wellhead hookup of an island well equipped for hydraulic pumping system.

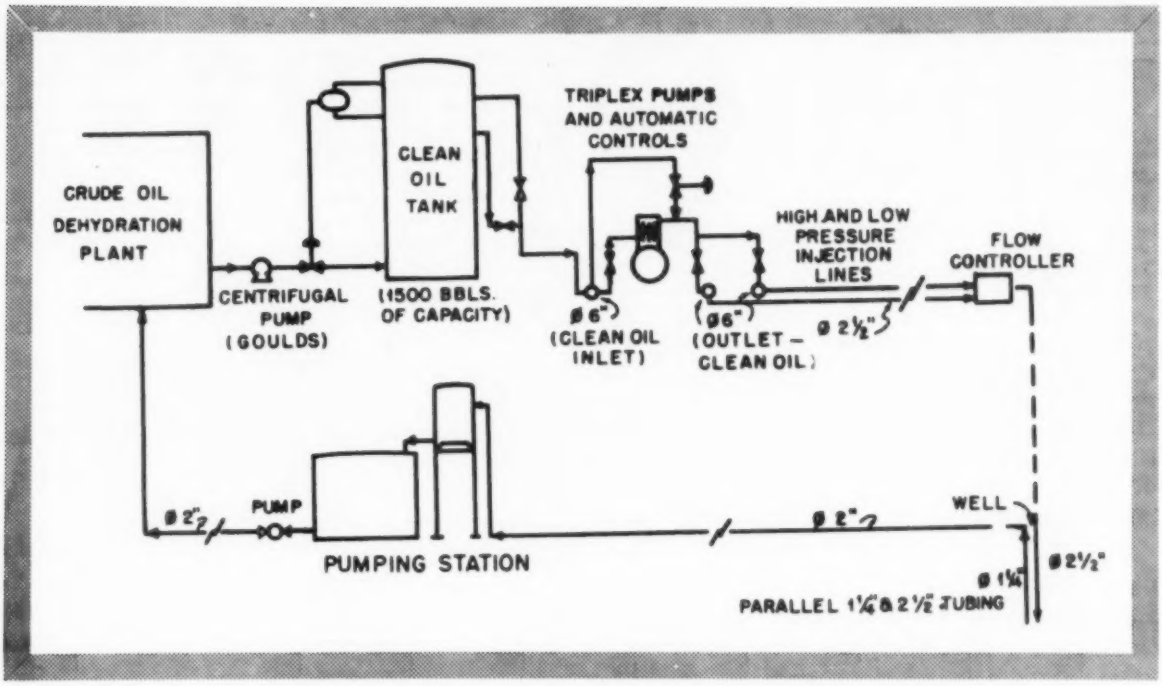


FIG. 3. **Schematic diagram of hydraulic pumping system** installed in the Galan field of northern Colombia. Dehydration plant cleaned the crude of water and sand for use as power oil.

RESERVOIR CHARACTERISTICS

The producing sands are loosely consolidated and for the most part are interspersed with rather incompetent shales. The sand grains are of diverse sizes and vary from very fine to pebbly. Much of the sand is so fine that it is carried easily in suspension by the oil. This condition is further aggravated by the high viscosity of the crude.

Formation pressure at −3250 ft (sub-sea) was 1100 psi as determined by pressure surveys made in 1955.

Characteristics of the oil are as follows:

Zone-A	
Gravity	19.5 API
Emulsion	1.0%
Temp at 4000 ft	120 F
Bubble point	1590 psi
Viscosity at 100 F	1190 SSU
Zone-B	
Gravity	19.0 API
Emulsion	0.5%
Temp at 5700 ft	135 F
Bubble point	2165 psi
Viscosity at 100 F	1036 SSU

Production Problems

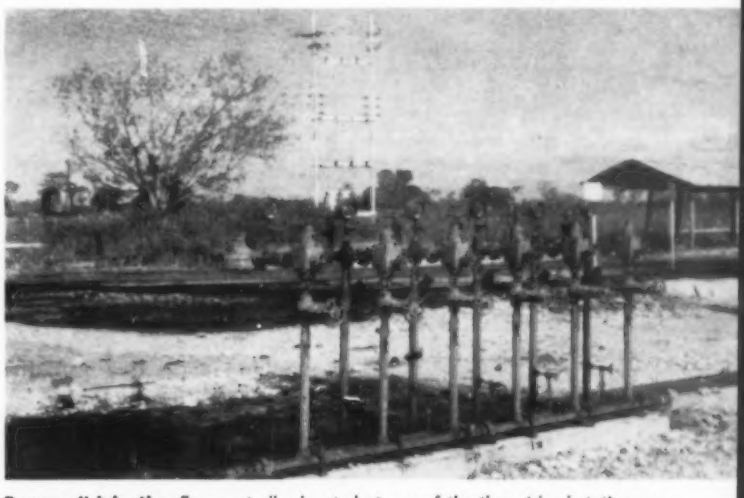
A great deal of difficulty has been encountered in keeping the wells on production because of the sand problem. Many have sanded up to the extent that prolonged fishing jobs were necessary to remove the tubing a joint at a time.

After the wells stopped flowing they were placed on the pump and in the case of directed wells the pump was placed as high as possible to prevent tubing and rod wear. It soon became obvious that it would be necessary to install rollers and tubing rotators on these wells or use some other method of pumping if the wells were to be kept on production.

HYDRAULIC PUMPING SYSTEM

Following a study of the conditions and all possibilities, the decision was made to install a hydraulic power oil pumping system. It was realized that the viscosity of the oil would reduce the efficiency, and removal of all sand from the power oil would be necessary. This was the first time such a pumping system had been used in Colombia. The company sent a production man to Los Angeles to be trained in its operation and repair.

The system was installed a year ago and in this last year, production from the 17 directed wells has totaled 450,000 bbl. While the efficiency has



Power oil injection flow controller located at one of the three island stations on the banks of the Magdalena River.

not been as high as was hoped, the system has done the job and the high initial cost and low average efficiency are offset by the elimination of tubing and rod wear and in reduction of fishing jobs.

Subsurface units. The subsurface equipment is composed of two paralleled strings of EU tubing, one 2½ in. and one 1¼ in., and a hydraulic downhole standard 2½ x 1¼ x 105-in. pumping unit with 18-in. stroke. With 21 complete units and only 16 wells pumping, there are five spare units. This allows time for repairs with some always available for replacement.

Surface equipment. The power oil which drives the hydraulic pumps is supplied from the Galan dehydration plant of 6000 bbl capacity where the oil from all 46 wells is also desalted. A centrifugal pump transfers the oil to a 1500-bbl tank near the power units. Oil enters this tank horizontally below a large conical plate mounted on a light, metal structure and rises in the annular space between the cone and the tank. This completes the desedimentation of the power oil. The suction is located a few feet from the top of the tank and the fluid level is maintained constant at two feet from the top by automatic controls.

The Author

William A. Gaviria *is a petroleum engineer in the production section of ECOPETROL's petroleum engineering department. He has held this position since February 1954. A native of Medellin, Antioquia, he completed a course in petroleum engineering at the School of Mines in Medellin, a section of the National University of Colombia, where he studied from 1949 to 1953. During two summers while an undergraduate, he worked for Shell-Condor at Casabe and ECOPETROL at El Centro.*

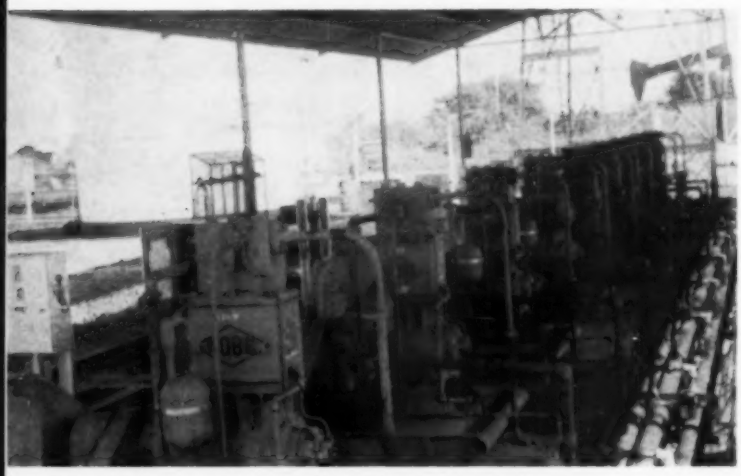
Four triplex surface pumps were found to be sufficient for the operation of the subsurface pumps on the 17 directed wells. Maximum rating of each of these pumps is:

Power	50 hp
Pressure	4400 psi
Speed	400 rpm
Vol per 100 rpm (1¼ in. pistons)	218 bbl/day

These triplex pumps pick up power oil from an adjoining 1500-bbl tank and deliver it at high pressure through 2½-in. lines to the islands. Actually there is one 2½-in. line to one of the islands and two paralleled 2½-in. lines serving both other islands. They are joined at each island so act as one larger line.

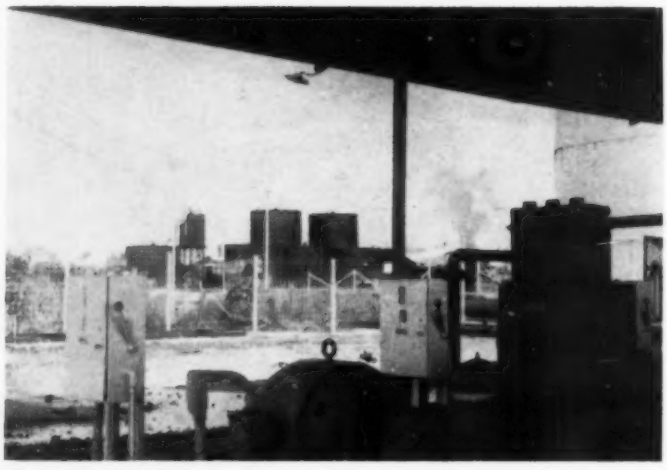
Originally it was thought that two ranges of pressures would be necessary so the two lines were laid. In operation, the injection pressures varied only from 2500 to 3500 psi, so both lines were connected at the two islands.

At each island, the power oil passes through controllers and a manifold system of valves, manometers and meters whereby the pressure and rate



Power oil pump station employing electric-driven triplex pumps.

Supply of power oil is stored in this 1500-bbl tank located adjacent to the pump station.



Dehydration plant serving the entire field is located near the hydraulic pump station shown in foreground.

LEBUS SPOOLING

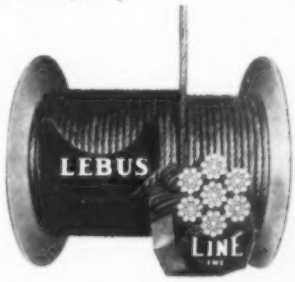
FOR ALL TYPES OF HOISTING UNITS

In addition to the standard grooved segments, LeBus provides a complete stock of Machine Grooved Split Adapter Sleeves for all sizes up to 2½" line and to fit up to a 36" "Drum" core for quick installation anywhere. This grooving is ideal for many types of drum grooving. For example, units already in operation requiring a line size change can quickly be converted with LeBus Split Adapter Sleeves. If two different size lines are used a removable sleeve can be installed. The LeBus Split Adapter Sleeve Grooving installation is flexible to meet any situation and may be easily and expertly bolted or welded by any good mechanic. Write today for complete details . . . enjoy trouble-free spooling this fast, easy way!

The above pictures a mechanic preparing to fit the second half of a machine grooved Split Sleeve or adapter for drilling and bolting. A Split Sleeve can be more easily welded. These installations can be made in factory, storage yard or on the job where hoist is operating.

WRITE FOR THE NEW 4TH EDITION OF THE LEBUS WIRELINE SPOOLING HANDBOOK . . .
Just off the press!

LeBus International Engineers, Inc.
LONGVIEW, TEXAS



LEBUS . . . WORLD HEADQUARTERS FOR *Engineered Spooling* COUNTERBALANCE · PYRAMID · HELICAL

of injection on each well is controlled.

The power oil then passes down the 2½-in. tubing, actuates the pump and returns to the surface through the 1¼-in. tubing along with the oil produced. The combined power oil and production passes through 2-in., low-pressure lines to the pumping stations from where it proceeds to the dehydration plant (Fig. 3).

Average injection characteristics are:

Pressure	3200 psi
Injection rate	150 bbl/day/well
Volumetric efficiency	53%
Production rate	80 bbl/day/well

Properties of clean, injected crude oil:

Gravity	19.5 API
Emulsion	0.05%
Viscosity at 100 F	1100-1200 SSU

Pumping Problems

One of the greatest difficulties in the operation of the hydraulic pumps is the amount of sand produced with the oil. This causes excessive pump wear and replacement and necessitates frequent clean-out work.

The high viscosity of the oil requires higher operating pressures and carries greater quantities of sand into the well. Similarly, the problem of cleaning it for power oil is more difficult.

Nearly 2500 bbl per day of clean, dehydrated crude oil is required for injection. This is approximately 50 percent of the total processed by the dehydration plant and it results in only about 1300 bbl per day of net oil production.

While 53 percent volumetric efficiency is quite low, it is due to only a few wells. Some are operating at 80 percent efficiency. The lower efficiencies of individual wells can undoubtedly be improved by proper study and control. Only a month ago the continuous sanding up of some of the wells caused a systematic study of the operations to be started but the resulting changes made since then have been in effect too short a time for any resulting differences to be noticeable.

Solving the sand problem. The early method of clean-out by moving in a work-over crew and equipment and bailing out the sand resulted in only temporary improvement and the costs were high. Recently, prolonged improvement has resulted from circulating the sand out with oil and displacing this circulating oil with a complete change over to clean oil. In addition to more prolonged effect, the method is less costly.

Another possibility is the use of lighter gravity oil for power oil if a satisfactory arrangement could be made with the refinery. As ECOPETROL is delivering about 24,000 bbl per day of 24 deg + API gravity oil to the refinery which adjoins the Galan field, it might be advantageous to divert the required 2500 bbl per day of this to use as power oil and deliver the resulting mixture of this and 1300 bbl of 19 deg API gravity to the refinery. Thus, the power oil would have a much lower viscosity and also the mixture returning to the surface would have a lower viscosity than the pure Galan crude. This should result in increased efficiency and considerably lowered circulating pressures.

Altogether, the use of the hydraulic pumping system in the Galan field has succeeded although the efficiency can and will be improved as the operators and engineers become more familiar with the conditions and results from variation in control of the individual wells.

Acknowledgment

Acknowledgment is made to the management of ECOPETROL for permission to publish this article; to Dr. Numael Nieto of the Production Department for information and assistance in general and to K. L. Vonder-Ahe for assistance in translation and editing.

* * *

The Tellurometer

Mapping Instrument Measures Distances With Accuracy Up to 1 in 300,000

A new highly exact mapping instrument, the Tellurometer, is soon to be used in the U. S. that is said to cut basic ground mapping costs and time by 75 percent or more.

At a recent demonstration near Doylestown, Pennsylvania, a group of 32 engineers saw the electronic tool measure distances of 27,414 ft within four inches. The tellurometer, which operates on radar principles, was developed in South Africa.

Although new in this country, the instrument has already proved itself in recent surveys in West Virginia, California, and in western Canada. A large survey is now being conducted by the Tellurometer in the Middle East.

The company who gave the Doylestown demonstration, Aero Service Corporation of Philadelphia, has purchased several of the instruments with which they plan to provide necessary ground measurements for air surveys for highways, railroads, pipelines, transmission lines, and other large scale developments.

Operation

The new instrument measures distance by phase comparison. A 10 megacycle crystal oscillator in the "master" instrument transmits a pulse, which is compared with a pulse from a similar oscillator in the "remote" station. The remote station transmits 1000 cycles above or below the 10 megacycle wave length. Rain or fog, daylight or dark do not affect operation.

Test demonstration of the new radar mapping tool near Doylestown, Pennsylvania, made measurements over distances of 27,414 ft — with an accuracy of four inches, or about 1 part in 80,000 accuracy.

Engineers say that the device can cut to one hour a 27,000 ft survey which would require at least two days for a three-man party to perform. Tests by the U. S. Coast & Geodetic Survey, using the instrument to survey a 20-mile base line, indicated that this work was done in one hour compared with three weeks for conventional chaining methods.

The instrument will be used for measurements ranging from one-half mile to 30 miles or more. On one recent test, over a 42,327 ft distance, the Tellurometer proved to be accurate up to 1 part in 300,000.

You Can Buy It in

COLOMBIA

Here are the companies, their locations and their personnel . . . your guide to oilfield service and supplies in Colombia

For the convenience of oil companies operating in Colombia we are listing here the affiliates and distributors of supply and service companies from whom you can get immediate attention.

Like the similar Venezuelan directory, copies of this are available without cost upon request to Management Editor, The Petroleum Engineer, P. O. Box 1589, Dallas 21, Texas, USA.

Revisions of the listing or additions will be made before the reprinting by writing to the above address.

Supply and Service Companies in Colombia

A-Z EXPORT, S. A.

Distributors for: Ideco Div. of Dresser International, Inc. (drilling masts; sub-structures; drive-in rambler rigs; swivels, rotaries; mud pumps, petroleum equipment and supplies.) Oil Base, Inc. (sales and service of all Oil Base, Inc. products which include Black Magic, Black Magic Supermix, Pepto Magic and Econo Magic oil base drilling fluids and additives, as well as White Magic emulsifier, No-Glo Oil, No-Glo Thread Lubricant, Mud Guns and Filter Presses.) H. C. Smith Oil Tool (rock bits and hole openers).

Bogota: Calle 19, No. 7-30. Telephone: 432-487. Cable: AZEXPORT, Marvar. M. R. Vollmer, manager.

BRIDGE, WALTER AND CO., LTD.

Distributor for: Dresser Manufacturing Div. Dresser Industries. (pipe couplings, fittings, repair clamps and sleeves).

Medellin: Apartado Aereo 649.

CIA. HALLIBURTON DE CEMENTACION Y FOMENTO

Bogota: Apartado Aereo 45-49. Avenida Jimenez No. 10-58, offices 404/405. Telephone: 20-276, 42 02 76. Cable: HALLIBURTON, Bogota. C. E. Heimann, manager.

Cucuta: % Colombian Petroleum Corp., Apartado 100.

El Centro: %Ecopetrol.

Puerto Nino: % Calderon Camp, Texas Petroleum Company.

Barrancabermeja: Casabe Camp, Shell Oil Company.

Casabe: Casabe Compamento C. P. S. C.

CONTINENTAL-EMSCO COMPANY

A division of The Youngstown Sheet and Tube Company, Inc. Suppliers and manufacturers of a complete line of oil field equipment for the oil and gas industry.

Bogota: Apartado Aereo 5700. Telephone: 452-459. Cable: CONEMSCO-Bogota. F. W. Dawson, sales representative.

EAST-WEST OILTOOLS, C. A.

(See Venezuela*)

GEOPHYSICAL SERVICE, INC.

Bogota: Apartado Aereo 7340. Seguros Bolivar Bldg., Room 906. Telephone: 489-381. Cable: GSI, BOGOTA. Murrell Holbert.

INTERNATIONAL GAS LIFT

(See Peru*)

MAGNER AND VILLA, LTDA.

Distributor for: Dresser Manufacturing Div. Dresser Industries. (pipe couplings, fittings, repair clamps and sleeves).

Bogota: Apartado Aereo 4083. Calle 14, No. 7-61.

MOTORES, S. A.

Distributor for: Oil Well Supply, division of United States Steel Corp.

Bogota: Carrera 13, No. 13-17.

OIL FIELD SALES AND SERVICES, S. A.

(See Venezuela*)

SERVICIOS INDUSTRIALES, C. A.

(See Venezuela*)

SUMICOL, LTD.

Representative for: The Hilliard Corporation.

Bogota: Apartado Aereo 3891. Cable: Sumicol. Senior Antonio Angel Sumicol, manager.

VARGAS, ALBERTO M.

Representative for: Clark Bros. Pan American Div., Dresser International, Pacific Pumps, Inc., one of the Dresser Industries.

Bogota: Apartado Aereo 6353.

UNITED GEOPHYSICAL CORPORATION

Caracas, Venezuela: Apartado 1085. Cable: UNITEDGEO, Caracas. G. G. Heilmann, supervisor.

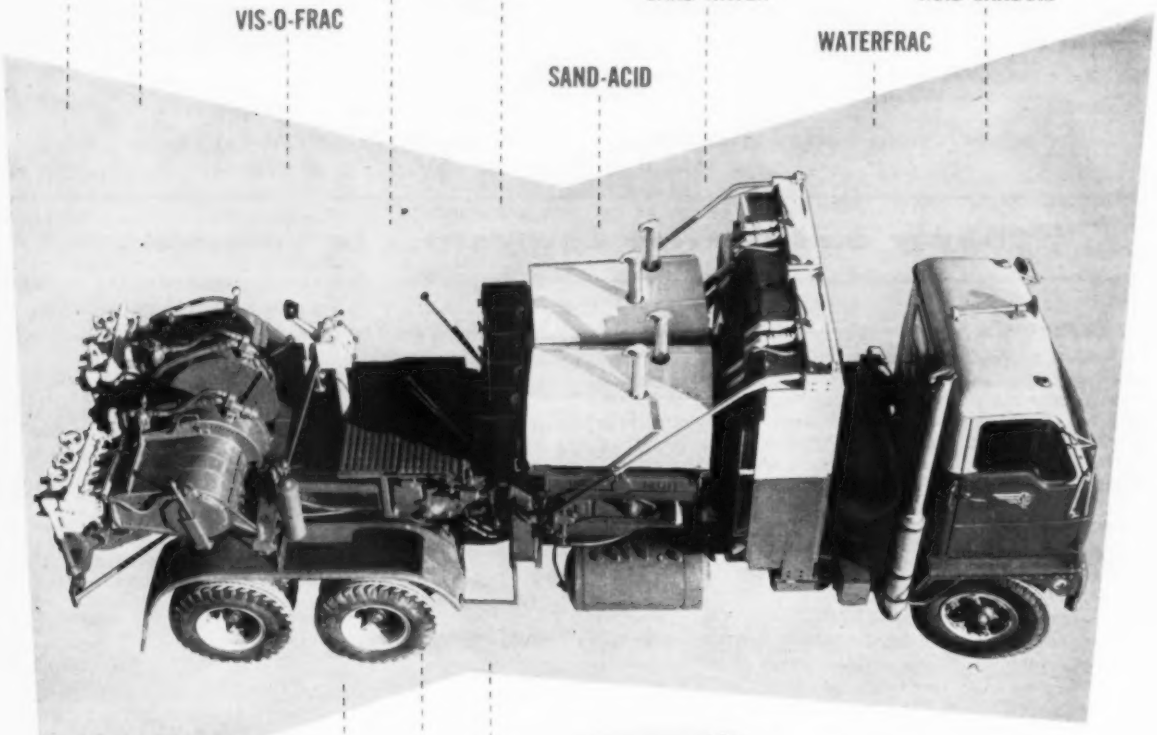
*Headquarters there has Colombia in its territory.

HALLIBURTON offers all basic fracturing techniques for better stimulation results

These are the basic techniques offered by Halliburton:

Halliburton pioneered fracturing and continues to set the pace in fracturing leadership by continuous perfection of basic techniques with new variations for temperamental formations. Halliburton's specially trained operators man the most advanced equipment to feel the pulse of your well and make possible constant flexible control throughout the fracturing operation.

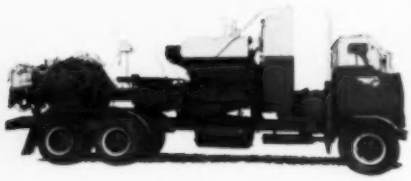
SANDOIL
ACIDFRAC
EMULSIFRAC
VIS-O-FRAC
HYDRAFRAC
SAND-ACID
SAND-WATER
WATERFRAC
ACID-SANDOIL



...and their variations:

FRACPAC
PERFPAC
MULTIFRAC
BIGFRAC
VERTIFRAC

Get your free copy of the *new* "Elements of Hydraulic Fracturing". Call your Halliburton representative or write:



HALLIBURTON FRACTURING SERVICES

HALLIBURTON OIL WELL CEMENTING COMPANY, DUNCAN, OKLAHOMA

THE PIONEER IN FRACTURING SERVICES

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

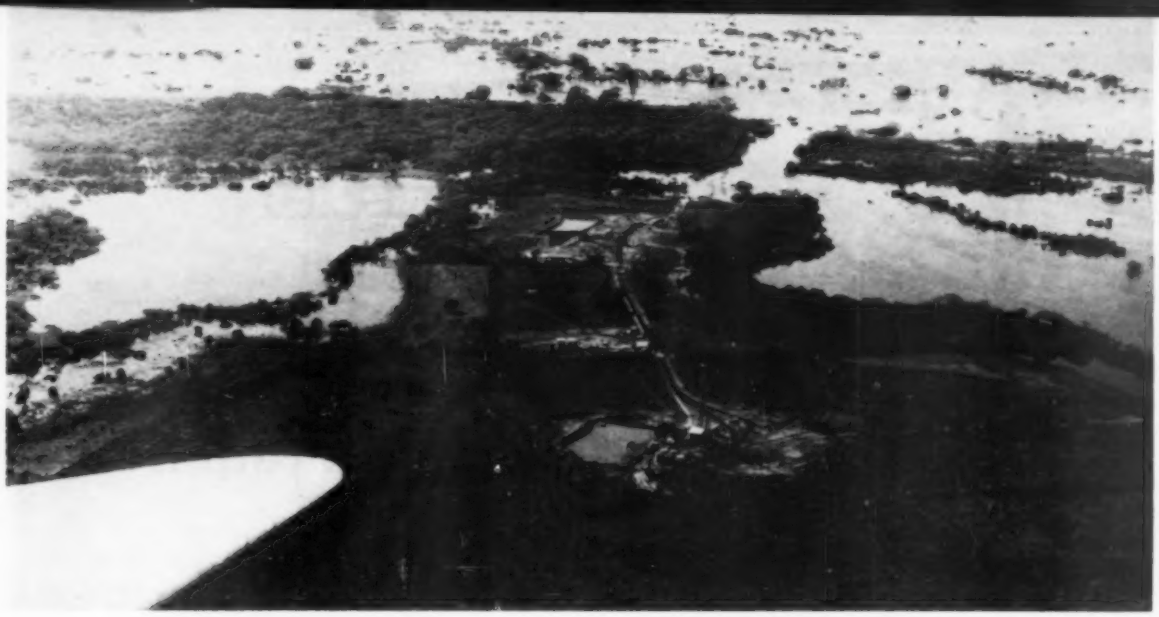


FIG. 1. **Colpet's Cicuco Concession** in the Middle Magdalena River valley includes swamplands and heavily wooded areas as shown above. Cicuco No. 1, discovery well, is completed in the background; Cicuco No. 2 is drilling.

P 414.3

In Colombia's marsh country, a host of drilling headaches

Development Problems on Colpet's Cicuco Concession

Swamplands, wide spacing pattern, lack of complete reservoir data make development drilling difficult

Clyde F. Dawson
Socony Mobil Oil Company, Inc.

The Colombian Petroleum Company acquired the Cicuco concession early in 1956. This concession is located in the Department of Bolivar approximately 180 kilometers south of Barranquilla. This area, in the Middle Magdalena River valley, is low, generally swampy, with some heavily wooded sections. Numerous streams and small rivers feed into the Magdalena River making transportation very difficult. The very low relief, about 5 in. per kilometer, impedes drainage and causes extreme changes in the water level of the rivers in the rainy season. The average change in water level from wet to dry season is about 18 ft.

Some seismic work had been done on the area before the concession was obtained by Colpet. This work was done with portable equipment, as the terrain made it impossible to use trucks. Late in 1956, a seismic party was moved in to obtain a better seismic picture of the area. Crews lived in houseboats on the Magdalena River. Portable drills were used and transportation was by boats and canoes. Two helicopters were used to supply the crew.

Location for Cicuco No. 1 was picked from the old seismic surveys. A portent of the problems involved in working in the area was received when the original location had to be moved over ½ a kilometer to place it on ground that would not be flooded during the rainy season. A contract rig was barged up the Magdalena River and Cicuco No. 1 was spudded on July 7, 1956.

The well reached total depth in 52 days, drilling 120 ft into limestone. An open-hole drill stem indicated possible production, so 9⅝-in. casing was set at the top of the pay. The open hole was acidized and a successful flowing test of 350 bbl per day was made.

Field Development

This successful wildcat indicated a potentially large field. Cicuco No. 2, a stepout on 90-acre spacing to the northwest, was updip to No. 1. It was completed for 180 bbl per day in fractured limestone and granite basement. The fact that only 45 ft of limestone was present in No. 2 raised the suspicion that a reef-type structure was involved. This consideration and the limited area above water led to the choice of the location of Cicuco No. 3, a stepout on a 45-acre spacing. Cicuco No. 3 confirmed the existence of production in the fractured basement. This well would not flow initially, and only after the fourth acid treatment was a rate of 170 bbl per day established.

Well spacing. At this time it became apparent that more than the usual amount of planning would be required to economically develop the field. The seismic picture indicated a faulted dome. Three wells had found production in three different formations. The nature of the reservoirs indicated low recoveries per acre might be expected, and it probably would not support such a close spacing as 45 acres.

Accordingly the next stepout, Cicuco No. 6, was drilled on a 90-acre spacing with an additional objective of finding the oil-water contact in the reservoir.

Product No. 677-C

FRACTURE
ACIDIZE
SWAB *and* TEST

as many intervals as required

... *in one round trip*

with BAKER RETRIEVABLE BRIDGE PLUG *and...*

SETS AND PACKS OFF AGAINST PRESSURE DIFFERENTIALS FROM EITHER ABOVE OR BELOW

After the Retrievable Bridge Plug has been run to the desired depth and released, it will automatically set and pack off against pressure differentials established from either above or below the tool.

CAN BE RUN IN AND RETRIEVED EASILY... OR MOVED AND RESET AS MANY TIMES AS REQUIRED

The number of times that the Retrievable Bridge Plug can be released, moved and reset is limited only by the number of operations in the well that require its use.

NUMEROUS ECONOMICAL APPLICATIONS

Used WITH the Baker Full-Bore Retrievable Cementer for:

(a) *Straddle Operations*
The distance to be straddled is not limited by the made-up length of tool.

(b) *MULTIPLE Zone or Selective Testing, Fracturing, Acidizing*

Used BY ITSELF for:

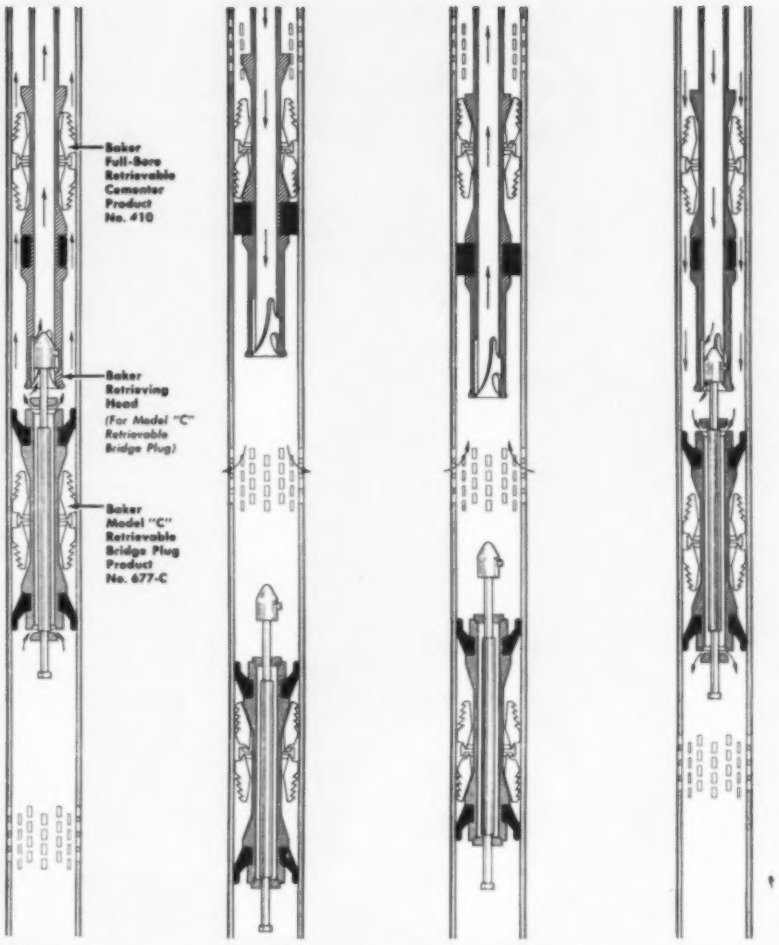
(a) "Down-the-casing" Fracturing or Acidizing

(b) Testing operations

(c) Temporary pressure containment to permit repair to or removal of well head equipment with safety.

Write for Catalog Supplement No. 319 for complete information on

TYPICAL OPERATION


Baker Full-Bore Retrievable Cementer Product No. 410
Baker Retrieving Head (For Model "C" Retrievable Bridge Plug)
Baker Model "C" Retrievable Bridge Plug Product No. 677-C

RUNNING-IN
Retrievable Bridge Plug being run into well on bottom of Full-Bore Cementer through use of Retrieving Head. Note fluid by-pass.

FRACTURING OR ACIDIZING
Plug should be pressure tested after release. Cementer is released, raised above perforations and reset for pressure operations.

SWABBING, TESTING
Note how the reversal of pressure differential has transferred load from one set of slips to the other (both cementer and plug).

RETRIEVING
Plug and Cementer being moved to next set of perforations—or retrieved from well. Valves in plug open to permit fluid by-pass.

Product No. 410

BAKER FULL-BORE RETRIEVABLE CEMENTER

HOLDS PRESSURE FROM EITHER ABOVE OR BELOW

Two sets of opposed slips enable the cementer to hold pressure from either above or below. Casing can be tested before squeeze—and the tubing also, if the Baker Full-Bore Tubing Tester is used.

FULL BORE CONSTRUCTION

Permits Passage of Tubing Perforators or Instruments—Assists in Preventing "Screen-Out" on Fracturing Jobs

The Full Bore through the Cementer (and Tester if used) is in reality a continuation of the bore through the tubing.

This continuous full ID passage not only permits passage of tubing perforators or instruments but assists in preventing "Screen-Out" (sand dropping out of the oil) and subsequent plugging of the tubing in fracturing jobs.

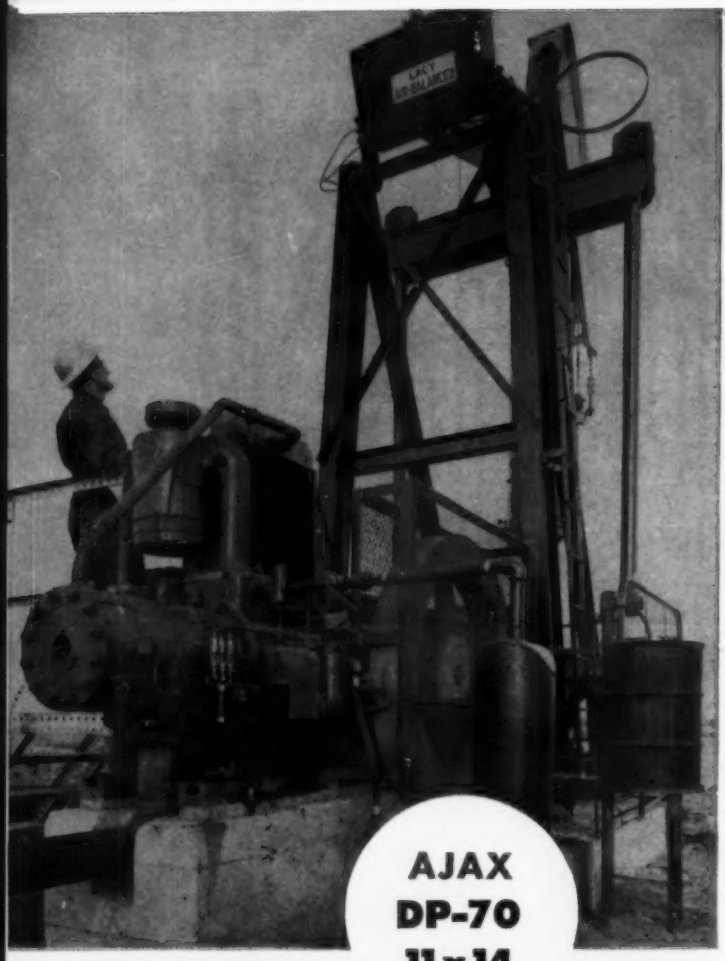
IDEAL STRADDLE TOOL WHEN USED WITH BAKER RETRIEVABLE BRIDGE PLUG

The operation of the Cementer setting mechanism makes it easy (through the use of the Retrievable Bridge Plug Retrieving Head) to release and pick-up the Baker Retrievable Bridge Plug. It is in fact the ideal partner to the Retrievable Bridge Plug for selective multiple-zone or single-zone operations.

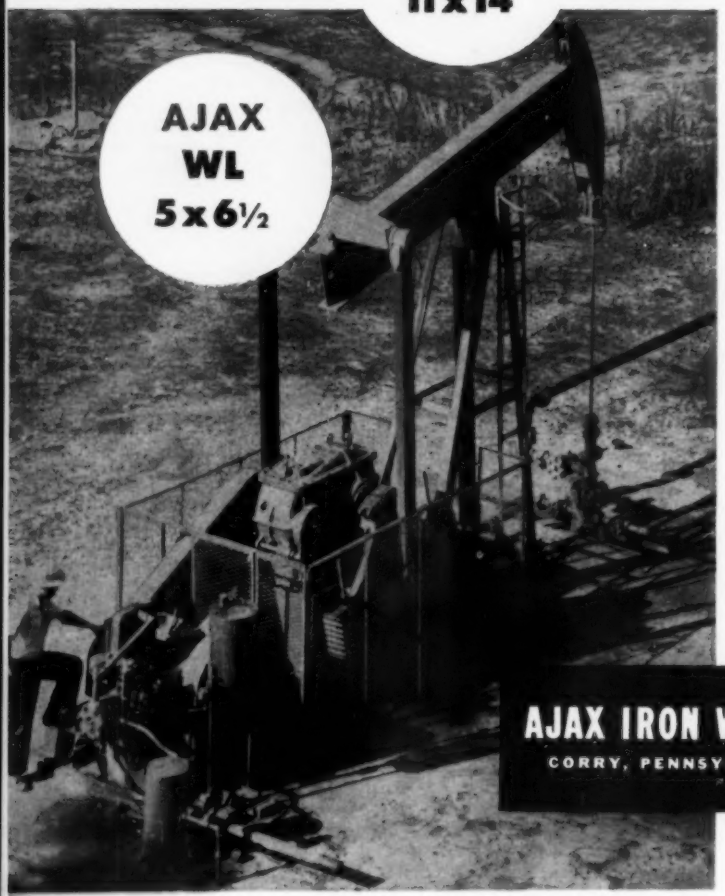
these products and their application

BAKER OIL TOOLS, INC.
HOUSTON • LOS ANGELES • NEW YORK

Product No. 677-C



AJAX
DP-70
11x14



AJAX
WL
5x6½

IN
Ajax ENGINES
LARGE or SMALL—

The payoff is in the performance

AJAX Gas Engines make money by the day because they cost less to run by the hour —and they pay for themselves every two or three years! This is the kind of performance only AJAX *and gas* can deliver.

• You owe it to your pocketbook to get the actual facts. Your Supply Man has the figures you need covering the complete range of AJAX Gas Engines—ask him to present them, promptly.

AJAX

AJAX IRON WORKS
CORRY, PENNSYLVANIA

Builders of GAS AND OIL ENGINES, PRESSURE PUMPS, STEAM ENGINES

Oil Field Distributors: THE NATIONAL SUPPLY CO., PITTSBURGH, PA.
R. B. MOORE SUPPLY CO., BOLIVAR, N.Y.
BETHLEHEM SUPPLY CO., TULSA, OKLAHOMA

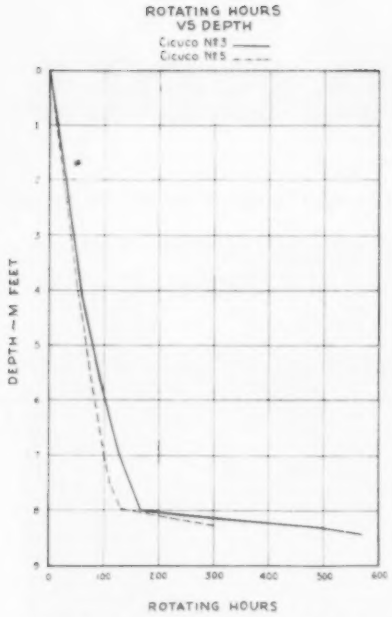


FIG. 2. Typical drilling rates in drilling development wells in Colpet's Cicuco Concession. Note reduction in time between well No. 5 and well No. 3.

This well placed the oil-water contact in the fractured basement at about 8200 ft subsea. Two long stepouts, No. 5 and No. 4, extended the productive area. The well Cicuco No. 4, increased the attractiveness of the area, when it was completed in the basement for 1550 bbl per day, the highest rate so far obtained in the field. The information now indicated a productive area of approximately 6600 acres, much of it underlying water or swamps. Fig. 1 illustrates the general topography; well No. 1 is in the background and No. 2 is drilling.

The difficult surface operating conditions combined with the nature of the reservoir made careful planning a must for economical development of the field. Studies had been undertaken to determine the best method of developing the field. Low expected recoveries made it necessary to delineate the reservoir and to obtain reservoir performance data for planning development drilling. The conclusion was reached that drilling on a 360-acre spacing would meet the above requirements. Having chosen the spacing and set a grid system, it was possible to attack the problem of getting to the locations.

Drilling methods evaluated. The first method considered was the use of drilling barges. The network of streams does not cover the area adequately to permit access to all the locations; therefore, a canal system would be required for barge movement. Although the operational costs of a water operation would be great, the possible use of a conventional submersible barge was recognized in areas that are continuously under water.

The construction of earthen drilling islands with connecting roads has been investigated. The soil in the area consists of clay mixed with silt and sand, and costs of development by this method may be high. As a first method of reaching a location under water, a directional well (Cicuco No. D-10) is now drilling from a dry land location to gain experience in directional drilling and evaluate the method economically.

Drilling

The geologic column in Cicuco may be broken into four general groups. Surface to 2000 ft contains fresh and brackish water sands which cannot be correlated from well to well. From 2000-3900 ft there are salt water sands and shales. In the interval from 3900-7900 ft, shale with erratic sand stringers exist. And, from 7900 ft to total depth is found the limestone-basement complex.

Drilling time. The plot of rotating hours versus depth in Fig. 2 illustrates that for bit selection the column may be broken into two groups. Long-tooth jet rock bits perform well in the interval 0-7900 ft, and hard-formation bits are required to drill the basement. Cicuco No. 3 is typical of the early wells drilled in the field, and Cicuco No. 5 is representative of recent drilling.

Casing program. A typical hole and casing program calls for: 130 ft of 13⅜ in. conductor casing, 1500 ft of 9⅝ in. surface string and a 6⅝ in. oil string to the top of the limestone, which is at about 7900 ft. Drilling is then resumed into the productive horizons with a 5¾-in. hole and a 5-in. perforated liner is set to total depth. The mud program shown in Table 1 has proved adequate.

There have been no serious drilling problems and it is anticipated that the average development well will require 35 days to drill and complete.

The directional hole, now at 9029 ft, had average penetration rates, with the expected additional time required for surveys and whipstock settings. No exceptional problem of directional control has been encountered and the well is right "on target."

Formation Evaluation

The limestone basement formations are competent though tending to cave in spots. However, open-hole drill stem testers have been used successfully. The oil-water contact in the reservoir was tentatively placed in Cicuco No. 6 by alternately drilling and testing.

Evaluation of wells by electrical logging has been difficult. Many types of conventional electric logs and radioactivity logs have been run. These logs are adequate to detect any possible oil-bearing sand in the sand-shale bodies, but cannot yet be used with confidence in the limestone-basement complex. Additional core studies and production data are required before a logging program may be selected that will yield reliable information on the fluid content of the limestone-basement formations.

Completion Techniques

The normal procedure in well completion has been to set 6⅝-in. casing at the top of pay, then drill in with mud and hang a liner. Tubing is run and the well washed with water, then oil, and swabbed to bring in production. Some of the early wells required one or more acid treatments to establish flow. The last two wells completed have had much higher initial flow rates than the early wells. Cicuco No. 4 produced 1640 bbl per day on a ⅜-in. choke and No. 7 produced 1780 bbl per day on the same size choke. There is insufficient data to state a definite reason for this, but it is possible that the longer periods of exposure of the formation to the drilling fluid plugged the fractures. Large-volume acid treatments or even oil squeezing may remedy any mud damage.

There are other factors that could explain the difference in initial potentials. The wells to date have found varying amounts of limestone, granite wash, and fractured basement that contain oil. The main reservoir cannot be identified as yet, nor what degree of interconnection exists between the reservoirs. Until these questions are resolved, it is difficult to evaluate completion methods. The one presently used is satisfactory until new data indicate otherwise.

The nature of the Cicuco field is such that an early solution to the problems of well spacing and well location is required to insure economic development of the field. A plan has been initiated that will obtain the necessary information to accomplish this objective. ★ ★ ★

TABLE 1. Cicuco Mud Program.

	0-1500 ft	1500-5000 ft	5000-7900 ft	7900-T.D.
Weight lb/gal	10.0-10.3	10.3-10.7	10.7-11.3	11.3-12.0
Viscosity, sec	40-48	42-50	48-60	55-65
Water Loss, cc API	7-9	6-8	5-7	2-3
Oil Content, % by Vol	12-14	12-14	12-14	12-14

BETHLEHEM SUPPLY CO., TULSA, OKLAHOMA

Colombia

AN ENGINEER GOES

The experience of living and working in a foreign land, with all its new excitements and difficulties, is seen through the eyes of an International Petroleum employee and his family, now making their home in Cartagena, Colombia

AMONG the three-quarters of a million Americans, including employees of Jersey affiliates, who now live and work abroad there are some who are provided with the comforts and conveniences they were used to in the United States. But there are other posts where Jersey affiliates encourage American employees to attend to their own living arrangements in the midst of a foreign community, and in these places the newcomers naturally have considerable adjusting to do.

This fact is carefully pointed out to prospective applicants, whether on college campuses or in the ranks of younger professional men, by the personnel men who recruit to fill vacancies abroad. And they make a point of interviewing the wives of applicants, too, for much of the burden of adjustment falls upon the women.

Mr. and Mrs. Robert H. Pearson, of Homewood, Illinois, after their interviews in the spring of 1956, both felt confident of their ability to adjust to life in Cartagena, Colombia, where International Petroleum (Colombia) Ltd. built a new refinery. Bob Pearson, then 32, had served abroad in World War II and had worked as a mechanical engineer for American oil companies.

His wife, Ruth Ann, called "Ran"—pretty, darkhaired and vivacious—had been an airline hostess before their marriage, and in college had majored in home economics. For Bob, the job promised interesting work with a substantial raise in pay; for his wife, "a chance to travel and live abroad while we're still young enough to enjoy the experience."

They disembarked at Cartagena in a relaxed and holiday mood. For days their ship had cruised luxuriously among the Caribbean islands, while Kenny, seven, and Stevie, two, turned brown on deck and their parents savored new sights and sounds. Cartagena, with its narrow, balconied streets, ancient forts, warm sun and steady sea breeze, seemed charming. Beside the swimming pool of a resort hotel, the Pearsons felt an understandable sense of adventure and good fortune.

Carriages take sightseers at a relaxed pace through balconied streets of the town.

The company helped them to find a house in a modern development, and as soon as they were settled they began the Spanish lessons which the company offers — 120 hours for Pearson, 60 hours for his wife. Nevertheless, before long the Pearsons began to feel baffled by the strangeness of the life and language around them.

Soon, in fact, they were gripped by a commonplace experience described by an American anthropologist, Dr. Kalervo Oberg, in an essay which Bob's company gave him to read, as "culture shock." Some of its symptoms are "excessive washing of the hands, excessive concern over drinking water, food, dishes, and bedding," and "dependence on long-term residents of one's nationality." Bob and Ran had a fairly light case, but they still remember it.

With several other young United States engineers, Bob was responsible for training many of the more than 300 Colombians who now operate a large refinery International built some 10 miles from the historic city.* The latticed towers of the refinery, already rising on his arrival, went onstream in the fall of 1957; the job of staff training was a race against time.

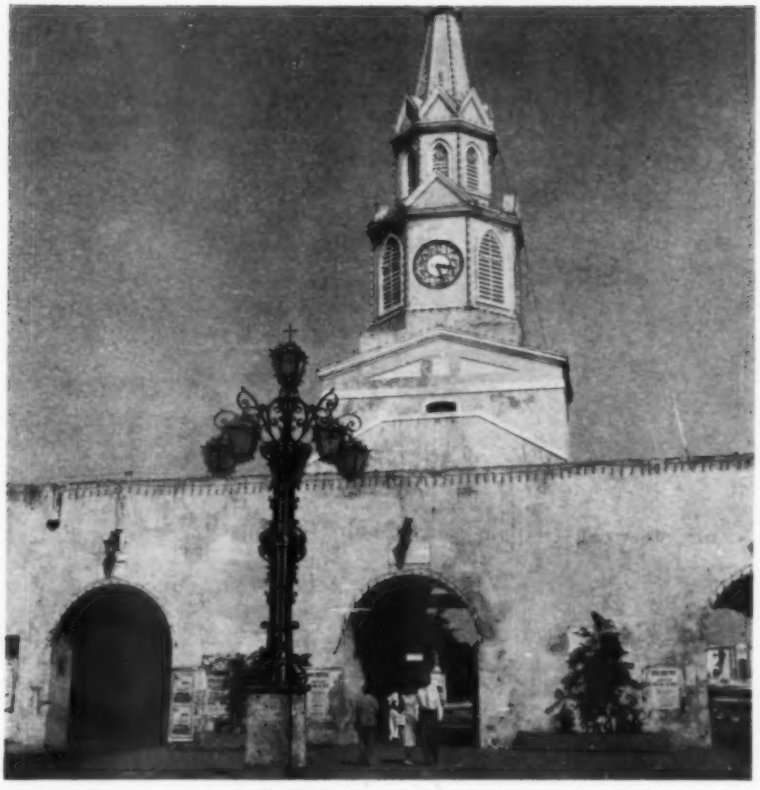
But Bob found more than a language barrier in the way. His trainees, Colombian high school graduates in their late teens or early 20s, were willing, but they lacked the background of mechanical experience common to most North American youngsters. And, as in the tropics everywhere, the value of time was simply not the same as in the temperate zone.

Meanwhile Ran Pearson had her

This article is reprinted from *The Lamp*, publication of Standard Oil Company (New Jersey), Fall issue, 1957; Edward R. Sammis is editor.

*See "Cartagena Refinery: The New Look in Overseas Plants," by Jon H. Baumgartner and Antonio Dorado, in The Refining Engineer, February 1957, Page C-7.

ABROAD



Cartagena, guarded by 40-ft walls, was founded in 1533. This is the main gate.

Tropical fruits like mangoes, bananas, pineapples, melons, and papayas abound in the city market. Ran Pearson, now that she knows Spanish, sometimes likes to go there.

Eloise, one of the Pearson's maids, has the help of a modern electric mixer.

own problems. The rented house had no telephone; as in other fast-growing cities, phone service could not be expanded as rapidly as people wanted it. If Ran also missed a few other things she had taken for granted in the United States, she was happy to have, at moderate cost, the fulltime services of two maids. True, they were country girls who needed instruction in many household duties, but they were kindly and good with the children.

Gradually the Pearsons learned to find their way around. For example, when the septic tank overflowed—on a saint's day, when it was hard to get a plumber — Ran used her beginner's Spanish to persuade a plumber to come. When one of the children fell ill at night, the Pearsons set forth and successfully located first a physician and then a druggist in the winding, sixteenth-century streets of the old town.

When the washing machine broke down, Ran, by drawing a picture for a shopkeeper, secured the necessary new part for her husband to install that evening. As clothes wore out, she found a seamstress who copied their shirts and dresses, at reasonable cost, in good Colombian textiles, and a shoemaker who made them shoes from fine Colombian leather. Meanwhile, all their Cartagena friends and acquaintances—for Colombians sincerely appreciate an effort by North Americans to learn their language — were giving them impromptu Spanish lessons.

The Pearsons' social life, imperceptibly, began to change from homesick gatherings of expatriates into a series of interesting experiences—a surprise serenade arranged by a Colombian friend early one morning under the balcony of a popular senorita, a bullfight, a weekend exploration of the remote, uninhabited offshore islands. When it was their turn to entertain, the

Walking the beach on Sunday afternoon, the Pearsons accept a ride in a sailing canoe.

Over 70 *Locations in the United States and Canada*

McCullough® REPORTS TO THE OIL INDUSTRY

Service *Anywhere Anytime*

New Services • • • New Tools • • • New Methods • • • Outstanding Results

Magna Tector/Chemical Cutter Recover 8905 Feet of Tubing

McCullough Magna-Tector and Chemical Cutter Recover 569′ of Tubing Below Stuck Point Shown by Instruments of Another Make

A free point locator was run in this Wyoming well, by another service company, to find the free point in a stuck string of 2½″ tubing. Instrument readings showed the tubing stuck at 8350′.

Operator was not satisfied and called McCullough to verify the lowest free point with the Magna-Tector.

Magna-Tector showed the tubing to be free at 8919′. McCullough's Chemical Tubing Cutter was run and a cut made at 8905′.

Due to the accuracy of the Magna-Tector in locating the lowest free point and the efficiency of the Chemical Cutter in cutting the tubing at the required location, the operator recovered all free tubing in one run of Chemical Cutter.

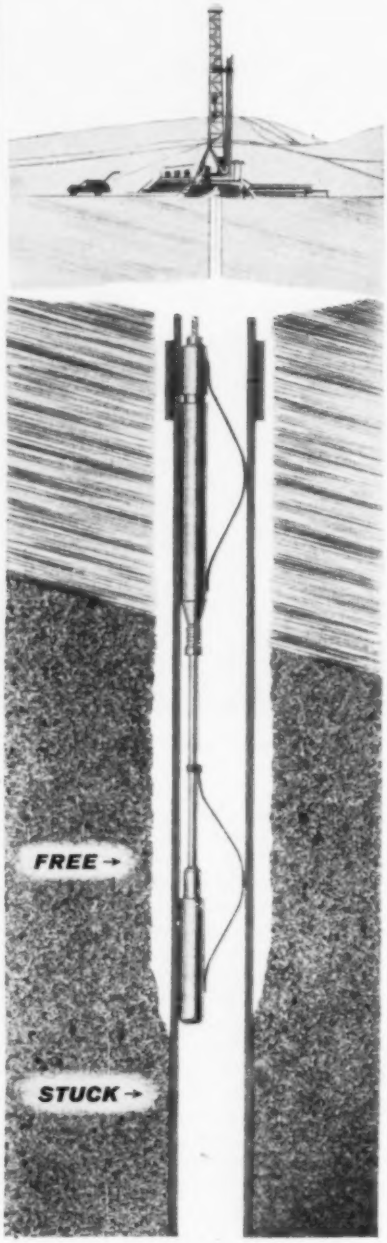
The entire job required only 4½ hours to complete, resulting in substantial savings in rig time and in costs that would have been required to remove the additional tubing by other methods.

The job shown above is certified to be a true field report of service rendered.

ACCURACY OF MAGNA-TECTOR HELPS RECOVER *ALL* FREE PIPE

When pipe is stuck, call for McCullough's Magna-Tector (Free Point Finder). Locates lowest free point, accurately and in a hurry. Paves the way for fastest recovery of all free pipe and speeds up remaining fishing operations. You save money, rig time and recover more pipe. Used in drill pipe, tubing and casing.

Ideal companion tools of the Magna-Tector—McCullough's String Shot Back-Off Tool, the Chemical Tubing Cutter, and Jet Casing Cutter. McCullough Service Engineers will give you full information and recommend the proper tool for your particular job.



McCullough® TOOL COMPANY

Cable Address: MACTOOL

LOS ANGELES
HOUSTON
EDMONTON

Pearsons gave an American-style beach party at which guests cooked their own hamburgers—a novel event to many Cartageneros.

At the refinery, meanwhile, Bob Pearson began to make faster progress with his Colombian trainees. A combination of a sound training program, intensive study by the trainees and physical labor gradually built an effective working team for the new refinery. Soon, trainees, had built a model of a fluid catalytic cracking unit and were rapidly preparing themselves for full-time jobs. International, like other Jersey affiliates abroad, has a policy of hiring citizens of the host country to fill as many positions as possible.

As time went on, the Pearsons continued to make friends. Through Colombian acquaintances they discovered corners of Cartagena the average tourist never sees, like the seventeenth-century cloister, shaded by giant trees, which was the home of San Pedro Claver, the Jesuit who devoted his life to bettering the lot of captives. He was known as the "slave of slaves" and eventually he became a patron saint of Colombia.

Bob Pearson, as the months go by, increasingly realizes that his work is not only profitable but useful. The technological training at the refinery opened new horizons to many Colombian youths. The refinery's operations help reduce Colombia's need to import gasoline and other oil products.

The Pearsons' chief motive in working overseas is still, of course, financial. Bob's pay is higher than for a comparable job back home, and he receives a cost-of-living allowance adjusted to prevailing price levels. A two-week local vacation in alternate years offers opportunities for seeing other parts of Colombia and neighboring countries, and in addition, the Pearsons, each two years, earn two months' home leave in the United States, with expenses paid by sea or air. If their children eventually attend high school or college in the U. S. they will be entitled to a yearly round trip at company expense.

Colombian friends show the Pearsons through the cloisters of La Popa, on top of the prominent hill which overlooks the city.

Latin rhythms predominate in the tea-dances attended by Cartageneros and tourists on the hotel terrace by the swimming pool. Note informal dress, which is the usual costume in the coast city on the Caribbean Sea.

In some ways, the Pearsons have found living abroad is cheaper, in other ways more costly. The future, however, looks very good. Bob Pearson can expect greater job opportunities as his experience qualifies him for other duties. Overseas employees with International (and some other Jersey affiliates) may retire if they wish as early as 50, though they do not have full pension rights until 60.

Meanwhile the Pearsons, in an active and interesting life, are storing up a rich fund of memories against that distant day. ★ ★ ★

INTERCOL TRIES NEW APPROACH WITH PERSONNEL

Company shifts responsibility for housing, schools and other facilities to the individual at Cartagena . . . Idea is to improve community integration, satisfy man's desire for independence in his home and community life

THE PETROLEUM INDUSTRY in countries abroad has encountered a number of problems outside of the operating area. Among the most important of these has been the need to establish and develop separate community facilities for employees in undeveloped areas.

At its new Cartagena refinery International Petroleum Company has not provided a camp and separate facilities for its employees, although this has been the usual procedure in Colombia as well as in other countries of Latin America in the past. Object of this new approach is to take another step toward freedom and responsibility of the individual.

Community Integration

The company gave its full support to a series of resolutions presented to the Petroleum Committee of the International Labor Office, which advocates community integration. These resolutions were unanimously accepted by employers, government, and labor in the belief the policies would be the best answer for the needs of the community, industry, employees, and citizens of the community.

In Cartagena, adequate housing, public utilities, medical services, and transportation exist. Intercol participates in providing schooling for overseas personnel by active and high level participation on the school board and economic support to the extent required to meet the school's objectives. A company-operated school will not be provided.

The company will assist where necessary in the development of such things as experienced craftsmen for home repair and better and more sanitary marketing facilities.

Opposes Company "Wards"

Along with this same policy of moving away from the paternalistic approach in housing, Intercol endeavors to strengthen the responsibility of its employees by working toward what it calls a "clean wage"—that is, pay high wages and minimize fringe benefits.

One of the major differences between the operations in Colombia and the United States is the difficulty in achieving this "clean wage." In the United States almost every company has its pension and other fringe benefit plans, but they are usually paid on the basis of percentage of salary and in effect are part of same.

In Colombia, the workers in many cases are almost "wards" of the company. In extreme cases, the worker is provided with medical care for his whole family at no cost, housing and utilities at nominal costs, and working clothing; a commissary is run where his family may obtain food at little or no mark-up.

A national law is now in effect which requires that a company set aside four percent of its payroll for a family subsidy. The proceeds therefrom are divided among the total number of eligible children in the families of the employees.

Overseas Employees Problems

This new approach to personnel problems affects all employees, but the North American arriving for his first assignment runs into special problems on his own.

Contrasts to his previous routine are immediately apparent in such things as language and food. Later, he becomes aware of differences in the conduct of business and standards of social behavior. The company does its best to explain these and other factors to new overseas employees before they head south, but it is impossible to make the picture complete. Consequently, the first weeks abroad are a period of considerable readjustment.

This readjustment may lead to a full and enjoyable life abroad or to a series of muffled gripes and complaints followed by a hasty return north. The result depends on the adaptability of the individual and his willingness to accept some inconveniences in return for compensating advantages.

One notable advantage of life in Cartagena is the availability of good domestic help at a price even a beginning engineer can afford. Many families feel that Cartagena's limited shopping facilities and the restrictions on imported goods are a small price to pay for year-around Miami-type weather and ocean swimming within walking distance.

One factor that seems to be of great importance for successful integration into life in Cartagena or any overseas location is a mastery of the language.

It is difficult to feel truly at ease in this environment without a good command of Spanish. Bachelors seem to make particularly rapid progress in this regard, due in no small part to the pretty and well-mannered Senoritas in the city.

Other factors that influence employees' opinion of overseas work include school facilities, vacations, and work schedules. Since Cartagena has no English-speaking school offering courses above the eighth grade, children attend high school and college in the north. Intercol provides transportation for yearly visits between parents and children.

Vacation schedules provide a paid 60-day vacation to the family's point of origin every second year, with a two-week local leave on alternate years. In addition, the company recognizes all official Colombian holidays, now totaling 18 per year. Overseas office employees work a 40-hr week but are on call for emergencies.

The new approach of Intercol marks an important directional change in employee relations. It will be interesting to watch the results. This greater independence should satisfy man's desire for freedom in seeking to improve his position in life.

Dependence is not banished overnight, however, and there may be a rough road before the objective is reached.

Sikorsky S-58 pinpoints supplies at a jungle drill site. Earlier the rig itself was airlifted in sections to the site by helicopter. The S-58 will carry two tons of cargo in its Utility version.

Offshore oil operations also find Sikorsky helicopters best for airlifting quantities of men or cargo. In the Gulf of Mexico area alone, Sikorsky S-58s and S-55s are carrying more than 27,000 passengers monthly to and from rigs.

Why build roads?

Eliminating the need for costly road building, big Sikorsky helicopters have pioneered a new technique for oil drilling operations. With loads averaging about two tons, they flew directly from supply bases to drilling sites in the New Guinea jungle. They carried crews, sectionalized oil rigs, and all materials needed for construction and operation, Only a few months were required. An estimated 18 months would have been needed to do the job using ground transportation.

Sikorsky helicopters—and only Sikorskys—have proved their dependability in such actual heavy cargo operations in jungles and other primitive areas. If you have a problem involving moving men or materials to hard-to-reach places, write for information on how well Sikorsky helicopters can do the job.

SIKORSKY AIRCRAFT
STRATFORD, CONNECTICUT
One of the Divisions of United Aircraft Corporation

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

P 420.112.51

Newest correlation tool is . . .

Surface Gamma Ray Logging of Subsurface Cores

R. E. Jenkins and Marc C. Meurer
Core Laboratories, Incorporated
Dallas, Texas

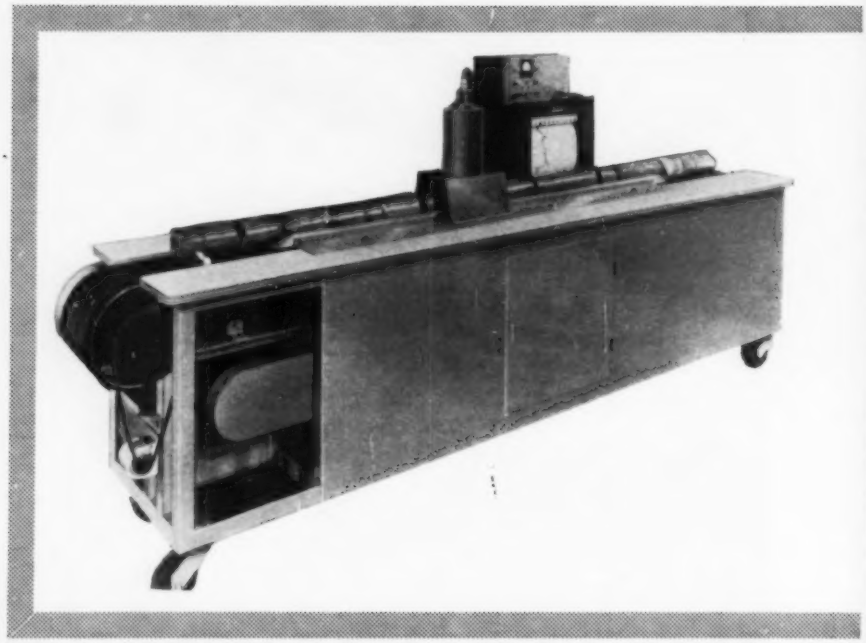


FIG. 1. **Surface gamma ray logs of well cores** are made by this device. Both the detector (left of recorder) and the core being logged are heavily shielded. Cores are conveyed through lead shield tunnel by endless belt driven at desired speed.

A NEW application of gamma ray logging is industry's newest formation correlation tool. This new technique involves monitoring the level of gamma radioactivity of subsurface cores after they are removed from wells. This surface log of cores, when compared with a conventional gamma ray log of the same well from which the cores were taken or of an offset well, provides the answers to a number of drilling and well completion problems. It is called the Core-Gamma Surface Log by Core Laboratories, Incorporated, of Dallas, Texas, developers of this new idea.

Primary function of the new surface gamma ray log is one of correlation with down-hole gamma ray logs. It provides accurately pin-pointed cored intervals and lost core sections. It will aid in eliminating depth discrepancies and excessive perforations. And, it can be used as an aid in determining accurate reserve estimates. Furthermore, the new surface logging technique provides a means for correlation of core analysis data with various down-hole logs.

A field idea. The process of measuring radioactivity of oilfield cores at the surface was initiated by a geological representative of an operating oil company. The operator had experienced difficulty in selecting the proper intervals to perforate in completing wells in the Queen sand formation in Andrews County, Texas. An excessive number of

When compared with conventional down-hole gamma ray logs, this new technique is a big aid to:

- Identifying lithology
- Determining proper depth from which cores are taken
- Perforating thin sections and laminated intervals at proper depths
- Locating intervals where cores are missing
- Accurately identifying formation boundaries

OFF THE SHELF–

NO REBORING–

NO KEYSEATING–

NO WAITING!

TAPER-LOCK SPROCKETS
SINGLE AND DOUBLE STRAND!

NOW Taper-Lock *Double* Strand Sprockets are available—from stock—ready for the shaft without re-machining!

They offer all the advantages of Taper-Lock mounting. Easy on! Easy off! Precision machined at the factory, they come to you with accurate, concentric bores —insuring full contact between hub and shaft. Taper-Lock grips with the firmness of a shrunk-on fit!

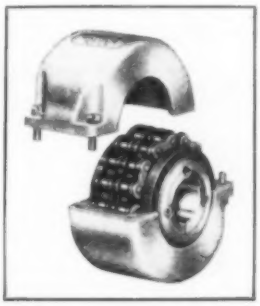
There is no flange, no collar, no protruding part. Flush design means *safety*... If the sprocket becomes worn, you replace only the tooth part. The bushing is used again and again. And Taper-Lock bushings are interchangeable in Dodge Taper-Lock Sheaves, Couplings and Conveyor Pulleys!

Taper-Lock Sprockets and Dodge Roller Chain (made to ASA standards) are stocked by Dodge distributors. Single Strand sizes range from No. 40 to No. 160, up to 112 teeth; Double Strand from No. 40-2 to 80-2, up to 102 teeth. Write for Bulletin A-644 containing selection, installation and maintenance data.

DODGE MANUFACTURING CORPORATION
7900 Union Street, Mishawaka, Indiana

DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new methods. Look for his name under "Power Transmission Machinery" in your classified phone book, or write us.



TAPER-LOCK CHAIN COUPLINGS

Accommodates common minor shaft misalignments. Provides strong, compact coupling. Available with covers, for appearance, safety, dirt protection and lubrication — which increases coupling life.

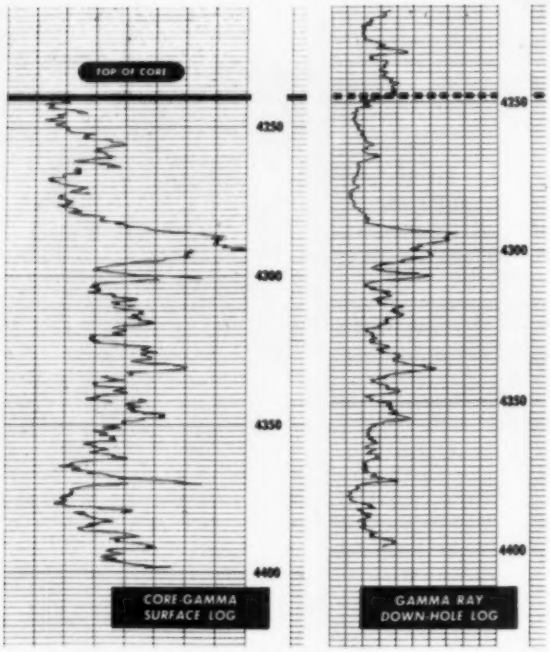


FIG. 2. **Discrepancy in core depth** is indicated by this comparison of surface and down-hole logs of the Grayburg-San Andres formation. An 8-ft difference was found between reported core depth and actual hole depth.

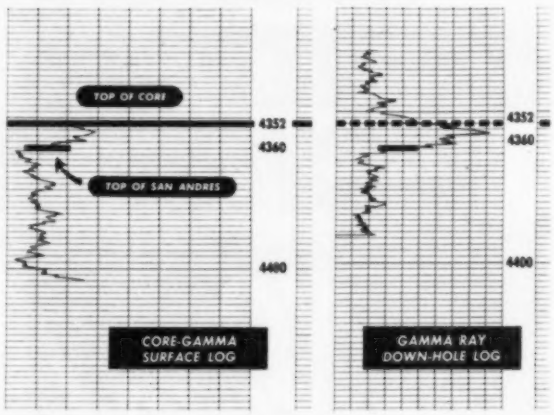


FIG. 3. **Position of core in geologic section** can be determined accurately from the surface log (left), thus minimizing footage cored.

perforations was being used in efforts to obtain successful completions. The operator reasoned that if the natural gamma radiation of the core could be correlated with the down-hole gamma ray log, depths of the productive sands indicated by core analysis could be determined accurately.

A 50-ft section of 4⅜-in. diameter Queen sand core was laid out on the cat walk and a gamma ray detector was moved over the core. The indicated gamma radiation of the core was drawn on a recorder chart to the same scale as a down-hole log. Although conditions for this work were far from ideal, the surface log was easily correlated with the down-hole gamma ray log and accurate depths were assigned to the core analysis data. As a result of this work, a successful well completion was made in a section of thin, laminated productive sand intervals with fewer perforations than had been used previously.

It was felt that there were many more benefits to be derived from the surface measurement of the radioactivity of cores and that the operation should be carried out in a laboratory under more favorable conditions. Results of additional studies performed in the laboratory during the past several months have shown conclusively that surface gamma ray logs of well

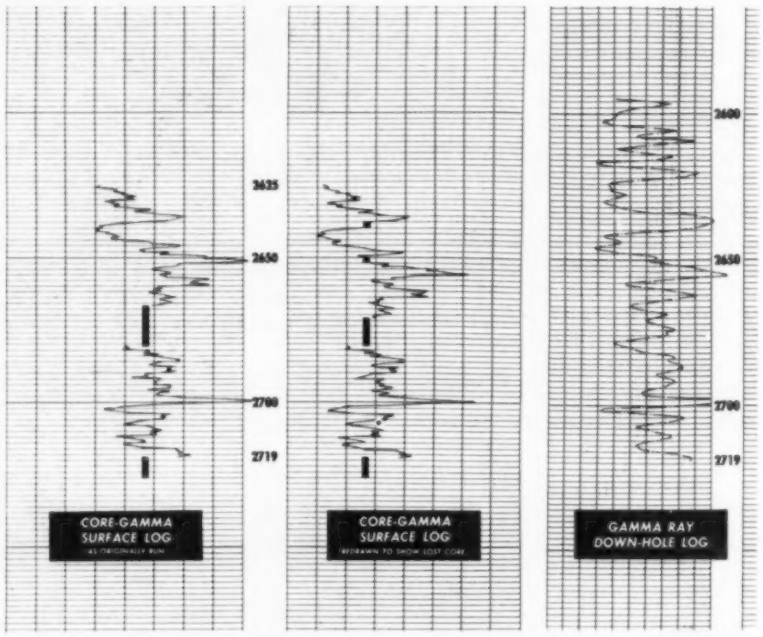
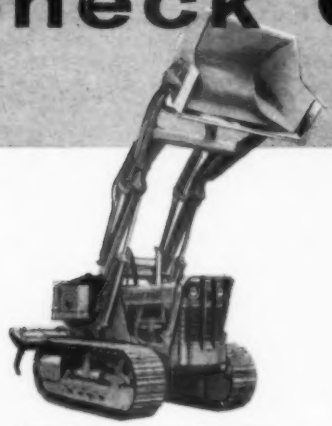


FIG. 4. **Lost core intervals** are determined accurately by adjusting surface log (left) to correlate with down-hole log (right). Center log shows actual lost core intervals.

Before you buy any tractor equipment...

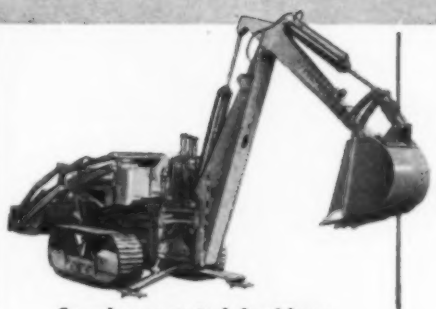
Check Case® TerraTrac®

PRICE AND PERFORMANCE!



Crawler-mounted loaders

Five sizes — ½ to 2-cu yd. — with exclusive "knock-out" dumping action, plus improved bucket rollback. Extra-high dump clearance simplifies loading high trucks and hoppers.

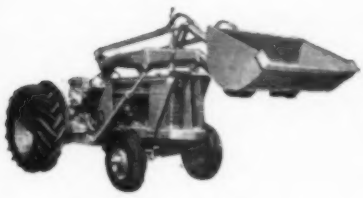


Crawler-mounted backhoes

Exceptional power and stability for tough digging in hard ground, steep grades, etc. Digs 12½' below grade. Available with various dipper sizes and optional front-end loader or dozer.

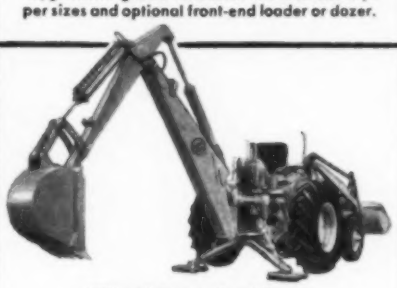
Crawler fork lift

Keeps jobs moving in any weather or terrain. Unloads trucks... carries, lifts materials to 21'4" height. Mounts quick-change loader, dozer, concrete bucket, log-grab, or crane hook.



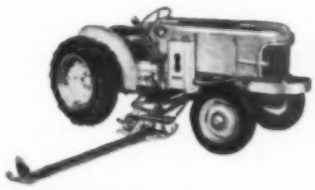
Wheel-type loaders

Beats any ½-yd. loader you ever saw for light loading, backfill and clean-up. 100% Case-engineered, Case-built, with heavy-duty lift-arms and automatic power-leveling.



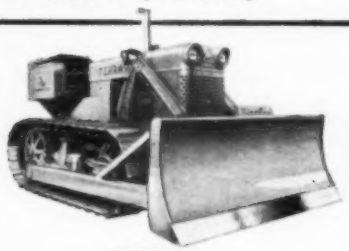
Wheel-type backhoes

Lowest-priced combination backhoe-loader on the market. Heavy-duty industrial design, with hydraulic foot-controlled 180° swing, telescoping stabilizers, many other advanced features.



Rubber-tired prime-movers

Three economical sizes — 42, 60 and 100 HP —with high-torque Case engine for operating mower, grader blade, etc. Also ideal for miscellaneous winching and drawbar work.

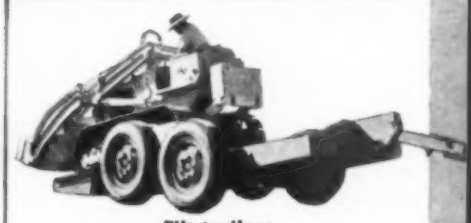


Bulldozers

Seven low-cost models under 80 HP — four with torque converters — plus larger sizes up to 100 HP, with max. 24,000 lbs. drawbar pull. Largest models feature optional "power-tilt."

Angledozers

Eleven gasoline and diesel-powered models from 42 to 100 HP. Largest models have torque-converter drive, instant power-shift, power steering—plus exclusive "power-angling" blade.



Tilt-trailers

4 or 8-ton capacity. Easily loaded or unloaded by one man. Available at saving of $500 to $1000 under competitive trailer prices with purchase of new TerraTrac crawler.

Maybe you didn't realize it... but J. I. Case Company now builds the *most advanced* line of industrial tractors and equipment of any single manufacturer in the 40 to 100 HP range. You can choose from a complete family of new Case-built prime-movers — *both wheel-type and crawlers* — plus a full line of matching loaders, bulldozers, backhoes, fork lifts and trailers. There's a rig for every need and budget — with just *one warranty, one service source, one easy financing arrangement,* on each complete machine. See your nearest Case Industrial Dealer for full details.

CASE INDUSTRIAL

1st in quality for over 100 years

Clip... Mail

J. I. CASE CO. Dept. B 1308, Racine, Wis., U.S.A.

Send literature and prices on equipment checked.

☐ Crawler loaders ☐ Crawler backhoes ☐ Fork lift
☐ Wheel loaders ☐ Wheel-type backhoes ☐ Rubber-tired prime-movers ☐ Bulldozers ☐ Angledozers ☐ Tilt-trailers

Name _____ Position _____

Company _____

Address _____

City _____ State _____

CT-CL-54

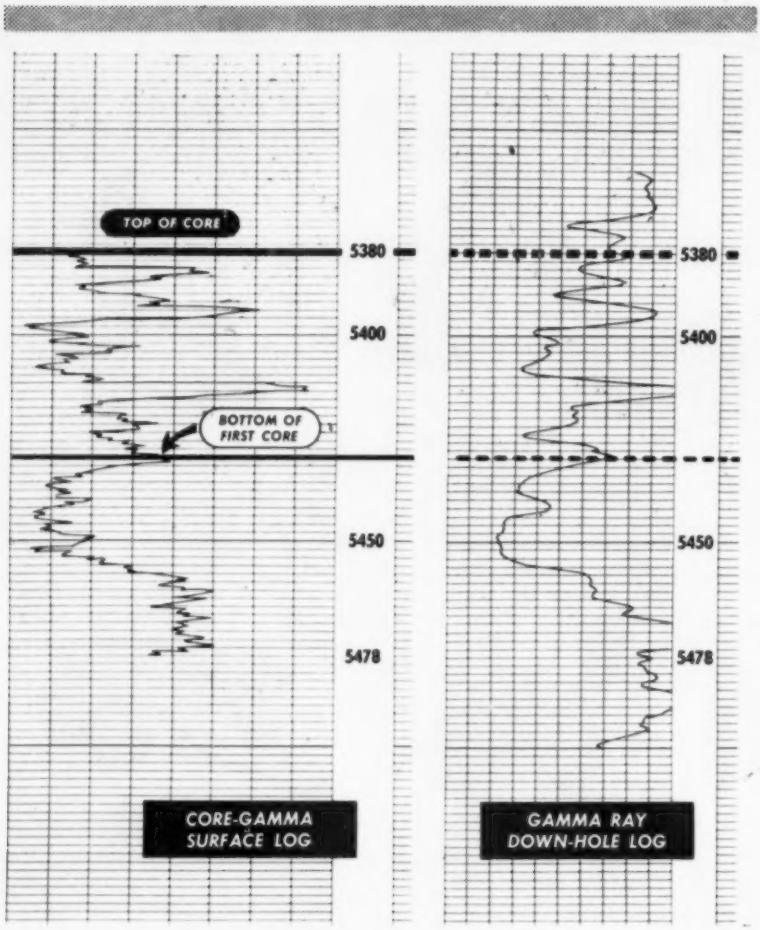


FIG. 5. **Surface core log** compared with conventional down-hole log of nearby well helped operator locate the McKee sand in Pecos County, Texas.

cores are very valuable for well completion purposes.

Equipment Used

Equipment used to measure gamma radiation of cores is shown in Fig. 1. The detector used to count radiation is a scintillometer, utilizing similar components and operating in the same manner as those used for down-hole gamma ray logging. The sensing element used in the detector is a sodium iodide crystal approximately 1½ in. in diameter and 4 in. long. This crystal and its associated electronic equipment "see" gamma radiations that emanate from the core, amplify the impulses and convert them into a signal that is recorded by a strip chart recorder to the same vertical scale used in the down-hole gamma ray log.

Cores move under detector. The detector element is positioned above a conveyor table so that cores, which move on a conveyor belt, will just pass under it. The detector is surrounded by a heavy lead shield to eliminate or minimize background radiation from the atmosphere. The shield is open at each end to allow the cores to pass through it and under the detector.

In the first laboratory installation, the detector was mobile and was moved past the cores. However, proper shielding from atmospheric radiation was not feasible with this arrangement and it proved to be much more practical to keep the detector stationary and to move the cores past it on a conveyor belt.

A heavy lead shield is mounted under the upper member of the conveyor belt to shield out background radiation originating below the core.

Variable speed conveyor. The conveyor belt which moves the cores past the detector can be driven at variable speeds, ranging from 2 to 5 ft per minute. Speed at which it is operated is primarily a matter of the rapidity with which the analyst can reconstruct the pieces of core on the conveyor belt. The conveyor belt drive is geared to the chart drive of the recorder through synchronous motors. Thus, vertical displacement of the recorder chart is proportional to the horizontal displacement of conveyor belt or core. The equipment is designed so that any popular scale can be achieved on the chart, e.g., 5 in. = 100 ft. Since this corresponds to the scale commonly used for down-hole detailed gamma ray logs, the two types of logs can be readily compared.

Logging Procedure

The core is logged from bottom to top (for any cored interval received in the laboratory), corresponding to the procedure used in logging the bore hole. The bottom of the core is placed under the detector and the recording pen is set on graph paper at the appropriate depth. The conveyor belt is started and core is fed to it until the entire interval has passed under the detector.

Characteristics. Experience has shown that the recorded curve will show minimum deflection or minimum radioactivity for salt, gypsum and clean sand, and a deflection ranging from low to intermediate for limestone and dolomite. As more radioactivity is encountered from shales and carbonaceous rocks, a greater deflection will be noted. Shape or character of the curve then allows one to make lithologic correlations.

Applications

The gamma ray curve is primarily a lithology identification curve, and principle value of this new tool is dependent upon availability of down-hole logs on the same or offset wells for correlation purposes. This correlation immediately informs the operator as to the position of his core in the section. He may then make such decisi ons as to stop coring, core ahead, test, or proceed with completion of the well. If the pay zone has not been reached as expected, the amount of additional necessary hole can normally be estimated fairly accurately.

Pinpointing core depths. Correlation of the gamma ray log of the core with the down-hole gamma log allows the operator to determine the proper depth from which the core came. It has been noted in many instances that the depths assigned to a core have been in error by 10 ft or more. If productive intervals are thin or the section is laminated, such a depth discrepancy could result in entirely missing the pay section, or in only partially covering the productive interval with perforations. As was noted earlier, correlation of the surface and down-hole logs may greatly reduce the number of perforations needed for successful completions in such situations.

Lost core intervals. Another valuable application of the correlation of the

going down for the truth

CORES *. . . undisputed evidence of the "hole" story !*

Coring is the best means to get information for exploration, field development and reservoir data. The superiority of matched Christensen Diamond core bits and barrels gives you *all the core* possible without loss from washing, blocking or grinding. There is a Christensen Diamond core bit and barrel designed for the most effective results in *any* formation. Call the Christensen Engineer today and operate at "Less Cost Per Foot!"

Do you have our catalog? Write today for SD 608-57.

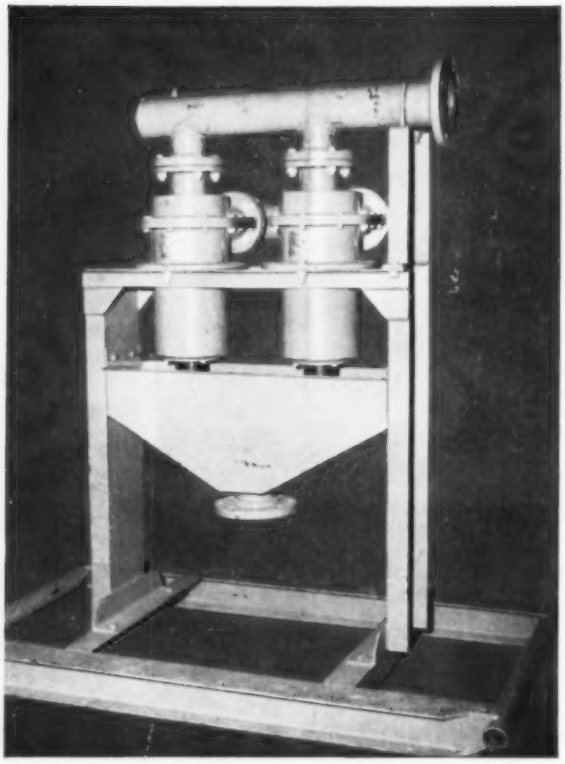
CHRISTENSEN DIAMOND PRODUCTS

1937 SOUTH 2nd WEST · SALT LAKE CITY 10, UTAH

Contact our office nearest your location for results of Christensen products in your area.

HERE IT IS...
a new 2-DorrClone
Dorrco
D-Sander

—designed especially for hard formation drilling



The new Size 2 Dorrco D-Sander is low in both first cost and operating cost. In addition, it is light in weight and easy to move. Designed especially for hard formation drilling with any rig, or slim hole drilling in a wide variety of formations, it brings the benefits of drilling fluids substantially free of drilled solids within the reach of every operator.

The benefits from using Dorrco D-Sanders are many. In many fields along the Gulf Coast, as well as other areas, abrasive sand can seriously reduce the life of bits and pump parts unless a D-Sander is used. In addition, the high viscosity of mud laden with drilled solids reduces drilling rates as much as 25 per cent.

In these areas, important savings in drilling costs result in that section of the hole where unweighted mud can be used.

But recent experience has proved that savings can also be realized in many other areas where abrasive formations are not encountered. In these areas, "flour sand" Dorrco D-Sanders, set to remove all drilled solids above 30 microns in size, result in greatly improved drilling speeds—sometimes in excess of 15 per cent.

In harder formations, drilling rates are slower and drilled solids are produced at a lower rate. In many of these areas, the Size 2 D-Sander, which provides capacities up to 250 gpm, is entirely adequate, yet it costs less to buy, to move and to operate than larger units.

The new Size 2 D-Sander compliments the capacity ranges of the larger sizes 4 and 6. With this new addition, Swaco offers units suitable for any rig and any drilling condition. Write for full information.

SWACO

SALT WATER CONTROL Inc.

A Sid Richardson Development Company

1211 Ft. Worth National Bank **Phone: ED 2-4434** **Ft. Worth, Texas**

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

designed specifically for controlling weighted muds...

The Dorr-Oliver ClayJector

Utilizing high centrifugal forces the Dorr-Oliver ClayJector — the most recent development for controlling weighted muds — provides a means for rejecting undesirable drilled solids and clays while minimizing barite losses from the mud system.

Maintaining optimum mud properties as dictated by local drilling conditions, the ClayJector minimizes tank jetting. On a recent series of holes, use of the ClayJector resulted in a conservative estimate of savings of $425 per day when compared with conventional jetting practices.

Key to ClayJector efficiency is the DorrClone classifier, a cylindro-conical unit. Four of these units are manifolded radially about a common feed, overflow, and underflow housing. Any of the units can be cut out of service to meet variations in circulation requirements by means of quick opening joints and blank flanges.

For more information on the ClayJector, contact our U. S. Sales Representative, Salt Water Control, Inc., 1211 Fort Worth National Bank Building, Fort Worth 2, Texas.

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U. S. A.

FOR FURTHER INFORMATION ON
ADVERTISED PRODUCTS, SEE READER SERVICE CARD

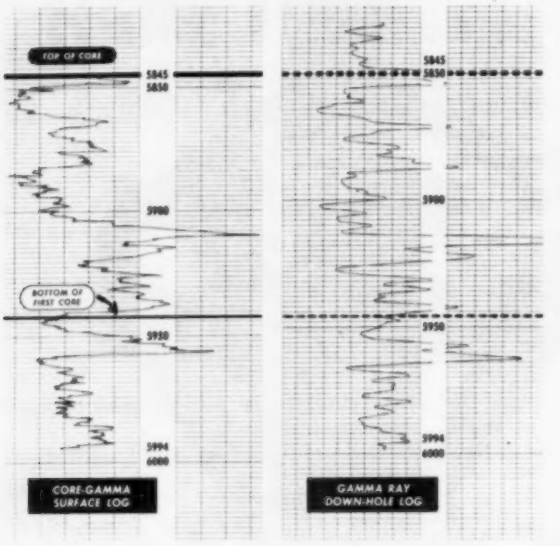


FIG. 6. **Locating desired pay section** in well logged at left was aided by comparing core analysis data and surface and down-hole logs. Main oil zone was indicated 12 ft below bottom of first core originally believed to be desired zone.

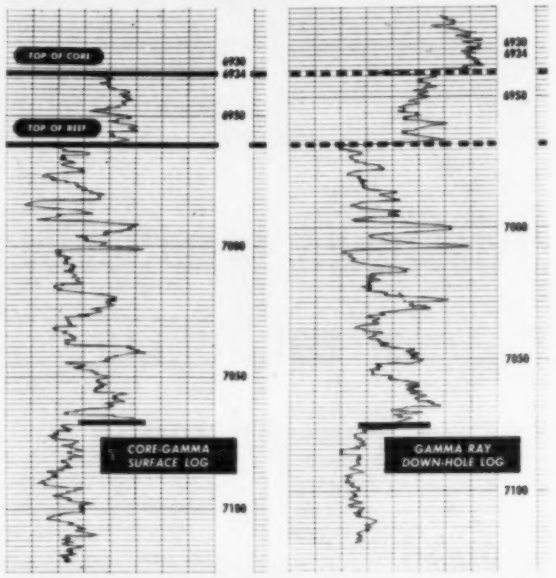


Fig. 7. **Retention of gamma radioactivity** in a core is illustrated by the surface log at left of cores that underwent vacuum distillation tests prior to logging. Comparison is made with down-hole log of same well.

surface and down-hole logs is its use in locating the intervals where core is lost. Knowledge of the exact relative positions of the cored intervals assures proper perforation with a minimum number of shots and, more important, it assures perforation at the proper points. The fact that the surface log is correlated with the down-hole log obtained by an instrument run on a wire line similar to the one used in perforating is additional assurance of the proper placement of the perforations.

Formation boundaries. Tops and bottoms of productive intervals can be determined accurately by core analysis, and these points can be transferred to the surface log. After correlation with the down-hole log of the same well, tops and bottoms can be transferred to logs of offset wells. These data may assist in the development of accurate isopachous maps. In this manner, use of the surface gamma ray log may lead to better reserve estimates.

Some Field Cases

The following examples are shown to illustrate some of the uses of this new core logging technique.

In Fig. 2, a comparison of the surface and down-hole logs of a section of Grayburg-San Andres shows an 8-ft discrepancy between the reported core depths and the actual hole depths. This information allowed the operator to select and accurately perforate the thin pay intervals of the formation.

It can be seen in Fig. 3 that the top of the San Andres formation in Ector County, Texas, is very apparent on the surface log. This shows that the position of a core in the geologic section can be accurately determined from the surface log, thus minimizing the amount of coring required.

Use of the surface log to accurately pinpoint intervals of lost cores is illustrated in Fig. 4. When the original surface log was run, the usual assumption was made that the lost core was at the bottom of the cored intervals. Comparison with the down-hole log showed this to be incorrect. After adjustments were made to correlate the surface log with the down-hole log, the true positions of the lost core intervals could be seen. These results are shown on the redrawn surface log. In this particular case, the results were very beneficial in pinpointing the proper completion intervals.

Fig. 5 illustrates how a surface gamma ray log of cores was helpful to an operator unfamiliar with the McKee formation in Pecos County, Texas. First core was cut from 5380 ft to 5430 ft, and some sand was encountered. The operator was not sure of the core position in the section, or whether the sand was shaled out, so a surface log was run on the core and correlated with the down-hole gamma ray log of a nearby well. Correlation indicated that by drilling through two more feet of shale, the sand in question would be encountered. Actually, after only one more foot of shale was drilled, the main sand body was encountered.

A similar situation is seen in Fig. 6, which shows the surface and down-hole logs of a section of the Glorietta formation in Andrews County, Texas. The operator had cored to 5942 ft and had the core analyzed. Results of the core analysis indicated some production, but when it was compared to the core analysis data on a nearby well there was some doubt that the desired pay section had been reached. A surface gamma ray log was run and compared with the down-hole log of an adjacent well, as shown in Fig. 6. Correlation indicated that a 10 to 12-ft shale section still separated the main oil producing zone from the section cored. Another core was cut, and the anticipated productive zone was found in the bottom 30 ft of the second core.

Gamma Ray Retention of Cores

Handling the cores during core analysis procedures does not alter the radioactivity characteristics of cores enough to prevent an accurate gamma ray surface log from being obtained. Fig. 7 shows the surface and down-hole logs of a section of the Strawn Reef formation in Nolan, County, Texas. The core was shipped from Abilene to Midland, Texas, where it underwent a vacuum distillation process before the surface log was run. It can be seen that all this handling had no appreciable effect on the natural radioactivity of the core.

With this new tool available to the industry, it is believed that many problems encountered by engineers and geologists will be solved or minimized. ★

Provides High Productivity... Anytime

After any perforating job, it is the production of the well that shows the difference between just perforating and perforating with the Welex Star-Jet. The Star-Jet is designed to give greater performance at less cost per perforation than any other standard perforator. Exhaustive laboratory and field testing have proved the Welex Star-Jet is the most economical perforator for the production it delivers. In tests conducted under the most strict regulations, the following official performance data was obtained: Entrance Hole – 0.50″, Penetration Depth – 9.00″ and Hole Volume – 29.00 cc.

The Welex Star-Jet is the newest shaped charge for casing perforating in the Welex line of unexcelled perforators. The Star-Jet is available, from any Welex district operating office, in three sizes – 3⅜″, 4″ and 5″ casing guns. Compare the results of the Star-Jet with any other standard perforator in field use today and you have proof that the Welex Star-Jet is the only standard perforator that gives you this outstanding performance at a minimum expense. Call your nearest Welex representative for the Welex Star-Jet and other top flight wireline service wherever and whenever it is needed.

ORIGINATORS OF Welex JET PERFORATING

WELEX, INC.

Fort Worth, Texas

*Trademark of Jet Research Center, Inc.

Division offices in Dallas, Denver, Houston, Los Angeles, Midland, New Orleans, Tulsa and Wichita • Subsidiaries in Canada, Peru and Trinidad

EXTRA Personalized service in the field and in your office *plus* main plant follow-through are your assurance of rigid attention to detail and accuracy.

EXTRA The Elgeneer – trained and experienced in every phase of modern logging techniques and equipment.

EXTRA The familiar green truck – modern mobile laboratories equipped with years-ahead equipment today. Maximum pinpoint precision logging on every job.

Write or call today!
An Elgen representative is ready to serve you.

THE **ELGEN** CORPORATION
2925 MERRELL ROAD / DALLAS, TEXAS
FLeetwood 7-3958

Mobile Drilling Platforms Make Intercontinental Moves

Two Texas-made portable drilling platforms have "moving" fever.

A "miniature" type platform which sold for a record-low price of $750,000, began a 10,000 mile voyage to the Persian Gulf where it will be added to the offshore fleet of Arabian American Oil Company. It is a tender-operated platform and will drill off Saudi Arabia.

Barnwell Offshore Company is considering a plan to move its "Mister Cap" 1000 miles south for drilling activity off the coast of Honduras.

Barnwell calculates that it can tow "Mister Cap" to Honduras and begin drilling, at less cost than transporting a conventional land rig 15 miles inland.

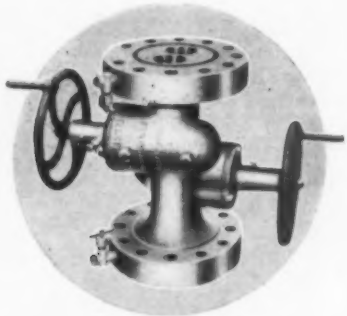
According to President R. S. Barnwell, Jr.:

"The reason we can do this, of course, is because our rig is completely self-contained and is extremely fast in going on location. Our holdings in Honduras (half interest in 51,000,000 acres) are both inland and offshore. Why transport a land rig 15 or 20 miles into the interior, when we can tow 'Mister Cap' there and drill offshore for less money?"

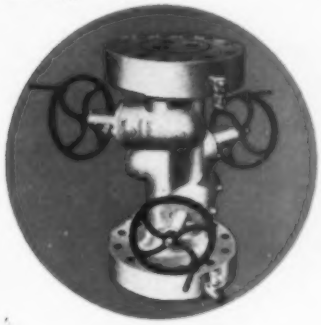
The big move, he said, probably would be made this summer, after present commitments for the platform off the Gulf Coast have been filled.

Both the Aramco and Barnwell units are of the tripod variety built by R. G. LeTourneau, Inc.

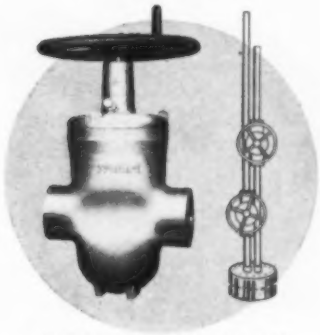
Dixilyn Drilling Corporation's new "Julie Ann," christened in January, is similar to new mobile platforms of Aramco and Barnwell. Julie Ann, however, has the distinction of having the longest legs (175 ft) of any of its three-legged cousins. It begins drilling operations in the Gulf of Mexico immediately.



DUAL VALVES
Sizes: 1½" x 1½", 1¾" x 1¾", 2" x 2", 2½" x 2½", 2" x 2½" and 2½" x 3".



TRIPLE VALVES
Size: 2" x 2" x 2".



RECESSED BODY VALVES
Sizes: 1½", 1¾", 2", 2½" and 3". Right Side or Left Side Recessed as ordered.

The same efficient flow control provided by standard W-K-M Through-Conduit Gate Valves is available for multiple completions with the W-K-M Dual, Triple and Recessed Body Gate Valves.

These valves provide turbulence-free through-conduit flow, W-K-M's exclusive CONTROLLED FORCE SEATING, DOUBLE-TIGHT SEALS* at both upstream and downstream seats and all the other important advantages of W-K-M standard valves.

Specify the W-K-M Dual and Triple Completion Valves for the most efficient trees. Where economy is paramount, specify the W-K-M Recessed Body Valve . . . identical internally with standard W-K-M Valves, but with a body recess to allow the necessary close fit between tubing strings.

W-K-M
DIVISION OF acf INDUSTRIES INCORPORATED

PLANT: MISSOURI CITY, TEXAS
MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

W-K-M IS A REGISTERED TRADEMARK OF ACF INDUSTRIES, INCORPORATED
PAT. PENDING. © 1957, ACF INDUSTRIES, INCORPORATED

Write Dept. F-2 for Bulletin WP 1057 for full information on W-K-M Valves for multiple completion. For complete details on W-K-M oil field valves, ask for Catalog 200.

MANUFACTURERS OF W-K-M GATE VALVES · ACF LUBRICATED PLUG VALVES · KEY-KAST ALLOY STEEL PIPING FITTINGS · KEY RETURN BENDS AND FITTINGS

5726

Shell's central terminal facilities on the east bank of Southwest Pass. Barge loading dock in upper right. Foundation for third 55,000-bbl main storage tank recently constructed at upper left. This installation can handle 50,000 bbl per day . . . has a storage capacity of 245,000 bbl.

P. 520.01

Two Offshore Fields Served By . . .

Shell's Giant Central Terminal Facilities

Block 24, Louisiana's largest oil field, and Block 27 fields in the South Pass area of the Mississippi Delta produce some 32,000 bbl daily into one central terminal having tankage capacity of 245,000 bbl

J. E. Kastrop,
Editor

LARGEST central terminal facilities to handle offshore oil and gas production in the Gulf of Mexico are located on the jelly-like banks of Southwest Pass in the Mississippi Delta some 80 miles south of New Orleans. On a 26-acre site that had to be raised four feet by pumping in sand, Shell Oil Company provided facilities to handle production from two offshore fields . . . Block 27 and Block 24 in the South Pass area. Block 24 is the largest oil field in Louisiana.

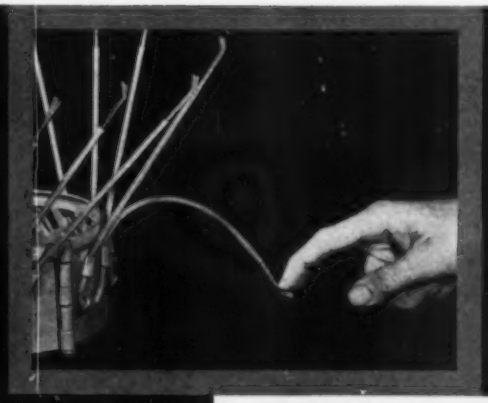
The central terminal facilities receive oil and gas through flow lines. Oil is sampled, measured in large lease tanks, then pumped into 55,000-bbl main storage tanks for transfer into barges. Some oil is treated before storage. Gas flows into a sales line when pressures are high enough; or it is compressed to sales line pressures. Shell's central terminal facilities at Southwest Pass handle some 32,000 bbl of oil and 30 to 35 million cu ft of gas daily. Barge loading facilities can load two 25,000-bbl barges and get them underway in about seven hours for shipment 100 miles up the Mississippi River to Shell's Norco refinery 20 miles west of New Orleans.

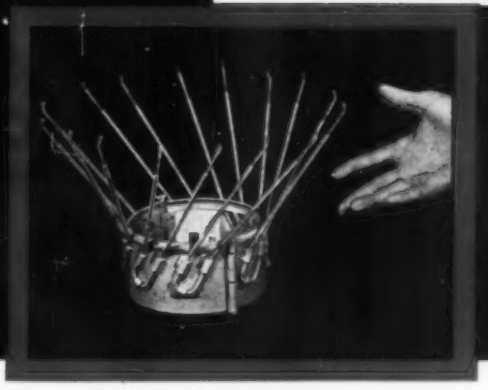
Original plans called for facilities

Continued on page B-82

WITH NEW
BJ RED TOP
SCRATCHERS–

The Spring is the thing!





BJ's exclusive coil-flex fingers assure you a better scratching job every time!

Look at the way the coil-spring-enclosed scratching fingers always bounce back to their original shape and position. The same thing happens when your BJ Red Top Scratcher is down hole. You get a better scratching job with fewer strokes because, unlike with an ordinary straight-wire scratcher, the Red Top's fingers never get kinked or bent out of shape—neither during installation nor in use—but stay at peak efficiency throughout their use.

Only the BJ Red Top scratcher has double-spring construction throughout. Each finger has a cluster of straight wires—for better scratching—encased in a tight coiled spring—for positive bounce-back.

Byron Jackson Scratchers are manufactured in sizes to fit all API casing OD's from 4½" to 13⅜". Every model features a sturdy hinged clamp-around design.

Specify BJ Red Tops next time and assure yourself better scratching and better cementing. They're sold through recognized supply stores and stocked in all BJ warehouses.

Byron Jackson Tools, Inc.
A SUBSIDIARY OF BORG-WARNER CORPORATION
P.O. Box 2017A, Terminal Annex, Los Angeles 54, California • Cable: "BJTOOL"
Export Address: 580 Fifth Avenue, Suite 510, New York 36, New York

WATCH BJ FOR THE NEWEST

The spring's the thing with BJ Red Top Centralizers too.
Write for literature that describes their unique design and operation

B. W. Armstrong, Regina, Can. | A. J. Artzer, Kimball, Nebr. | R. V. Atkinson, London, Eng. | E. H. Austin, Houston, Tex. | L. L. Ballew, Oklahoma City, Okla. | D. F. Barton, Ardmore, Okla. | W. H. Batchman, Ellinwood, Kans. | A. L. Beavers, Houston, Tex. | J. F. Belk, Calgary, Can. | C. G. Bell, Andrews, Tex. | T. G. Berryhill, Duncan, Okla.

D. E. Blacksten, Bakersfield, Calif. | W. M. Blaxton, Shreveport, La. | L. G. Botts, Las Morochas, Venez. | R. B. Bowden, Pampa, Tex. | C. O. Bridges, Sundown, Tex. | W. W. Bryant, Pampa, Tex. | N. K. Burkett, Laurel, Miss. | M. S. Caraway, Wichita Falls, Tex. | R. D. Cassel, Los Angeles, Calif. | E. M. Christensen, Edmonton, Can. | F. D. Church, Andrews, Tex.

J. W. Clark, Cody, Wyo. | F. M. Clowdus, Wichita Falls, Tex. | L. C. Combs, Casper, Wyo. | J. F. Cook, Tulsa, Okla. | G. M. Cowie, Edmonton, Can. | B. R. Cox, Midland, Tex. | W. G. Crow, Odessa, Tex. | F. E. Crunk, Casper, Wyo. | H. V. Cunningham, Estevan, Can. | B. L. Davis, Seminole, Okla. | D. A. Davis, Houston, Tex.

J. Dennis, Winnsboro, Tex. | J. F. Epley, Casper, Wyo. | A. L. Fillerup, Billings, Mont. | E. E. Fullingim, Victoria, Tex. | J. O. Gabrielle, Morgan City, La. | W. M. Golden, Pratt, Kans. | H. C. Gray, Odessa, Tex. | J. N. Gray, Odessa, Tex.

J. T. Green, Casper, Wyo. | J. M. Guinn, Corpus Christi, Tex. | A. M. Hackler, Wichita Falls, Tex.

FOR COMPLETE SERVICE HARMONY

R. G. Hamilton, Sundown, Tex. | S. W. Hardcastle, Shreveport, La.

W. W. Havard, Anaco, Venez. | V. L. Hawkes, Edmonton, Can. | A. L. Hawkins, Graham, Tex. | J. E. Hawkins, Hadacol Corners, Tex.

J. S. Hawley, Jr., Odessa, Tex. | R. L. Hedgpeth, Odessa, Tex. | G. Hensley, Oklahoma City, Okla. | A. H. Johnson, Los Angeles, Calif. | B. R. Johnson, Hobbs, N. Mex. | H. L. Jones, Shreveport, La. | N. W. Kramosky, Edmonton, Can. | C. W. Lee, Abilene, Tex. | C. W. Lyon, Houston, Tex. | R. C. Loe, Shreveport, La. | E. W. Longmire, Dallas, Tex.

Go CONTINENTAL-EMSCO

L. L. Lossett, Jr., Harvey, La. | B. D. Love, Hobbs, N. Mex. | J. L. Lusk, Odessa, Tex. | T. A. Mann, Tulsa, Okla. | J. S. Martin, Tulsa, Okla. | H. L. Mauldin, Abilene, Tex. | J. I. McQuiddy, Casper, Wyo. | B. V. Mills, Morgan City, La. | R. L. Hicks, Snyder, Tex. | M. E. Moore, Kilgore, Tex. | H. E. Moudy, Ellinwood, Kans.

D+B

Specialists..Parts.. and Service Keep Your Wells Producing

Continental-Emsco D+B pump repairmen are located in C-E pump shops near your producing wells. They have a thorough knowledge of subsurface pumps, regardless of make or manufacturer. D+B specialists are company trained and seasoned by day-to-day contacts with the pump problems of their area. They are furnished the best in pump shop equipment . . much of it designed and built to C-E specifications. Let us repair your pump with D+B replacement parts . . *the best buy of the industry* with our field pick-up and delivery.

for Service

B. J. Murray
Harvey, La.

G. R. Nichols
Hobbs, N. Mex.

B. Oliver
Healdton, Okla.

P. W. Parker
Corpus Christi, Tex.

B. J. Peery
Falfurrias, Tex.

V. D. Pierce
Abilene, Tex.

F. C. Place
Oklahoma City, Okla.

J. D. Poole
El Dorado, Kans.

H. W. Pringle
Great Bend, Kans.

J. C. Pullen
Bakersfield, Calif.

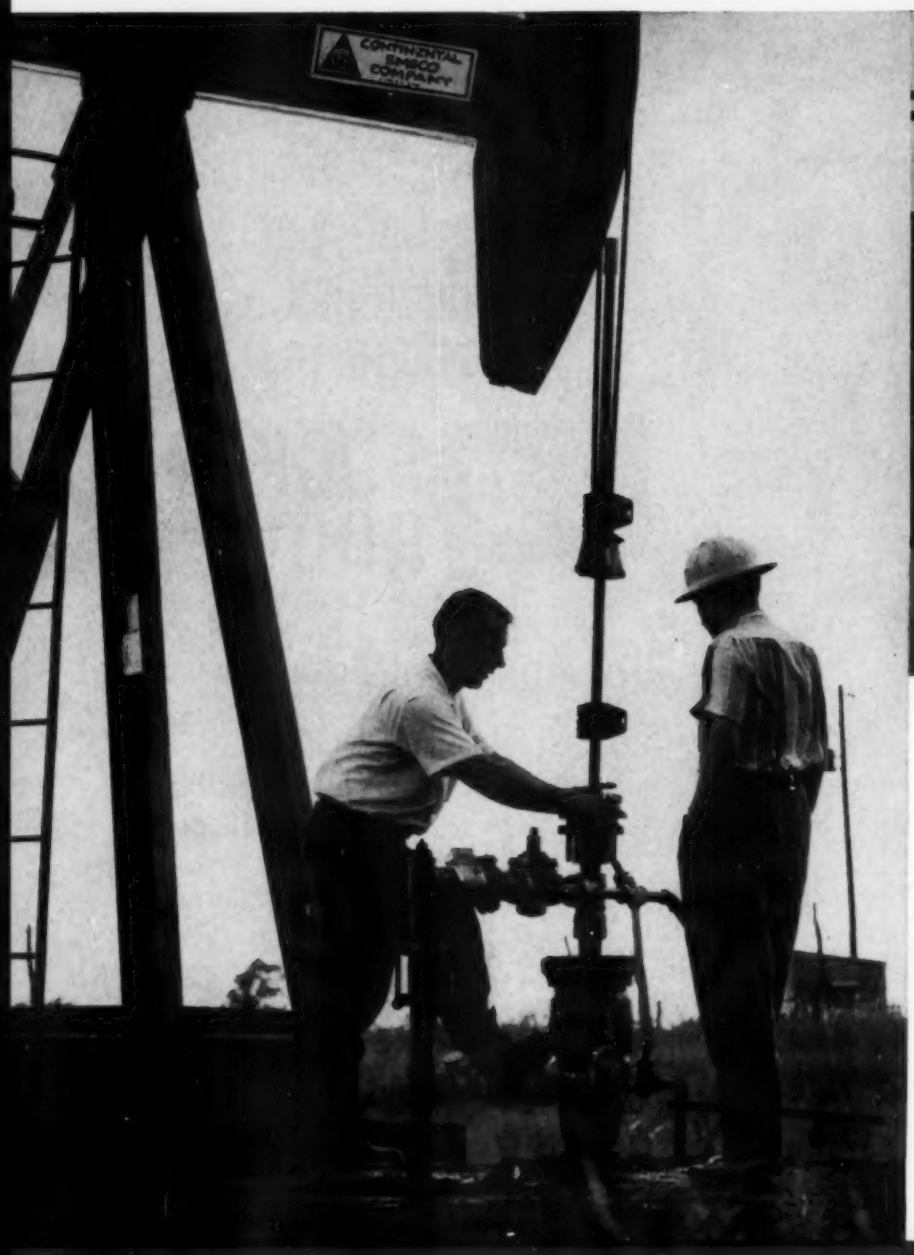
Your Continental-Emsco Man Can Cut Production Costs with the Right

D+B SUCKER ROD

When planning to put a well on the pump, rely upon the experience of your Continental-Emsco man. Day-by-day contacts with the producing wells of the area give him invaluable experience on the proper size and grade of D+B sucker rods and other subsurface equipment to use in your wells. When you rely on Continental-Emsco, costly equipment failures are reduced to a minimum. Talk to your D+B man.. he has the answers for lower pumping costs.

...that Sings..

C. A. Reardon, Odessa, Tex. | O. B. Reed, Monahans, Tex. | F. H. Rinne, Los Angeles, Calif. | J. G. Ritchey, Houston, Tex. | L. W. Ryan, Hobbs, N. Mex. | D. D. Sands, Midland, Tex. | F. H. Schillinger, Shreveport, La. | W. E. Schmidt, Las Morochas, Venez. | M. D. Seiley, Morgan City, La. | W. L. Shields, Salem, Ill. | E. C. Shoemate, Drumright, Okla.



On-

..Keep
Hum

Continer
always
sonnel v
pumpers
your pe
speeds .
check o
Learn t
you avoi
costly, p
will incr

Equipment

Lift Here for Lower Production Costs

J. Silhavy, Odessa, Tex. | J. Silhavy, New Iberia, La. | D. O. Smith, Morgan City, La. | H. C. Smith, Casper, Wyo. | V. C. Smith, Jr., Corpus Christi, Tex. | R. L. Snider, Tyler, Tex. | W. W. Thomas, Odessa, Tex. | W. R. Thompso, Nocona, Tex.

C-E Service Backs Up Every Continental-Emsco Pumping Power Unit

A C-E serviceman is always available to help with engine and electric motor maintenance and repairs. He can also analyze your pumping requirements, power sources and changing well conditions. His analysis will show the correct C-E Pumping Engine or C-E Green Triangle Electric Motor size to give you maximum pumping efficiency at the lowest possible power cost.

n-Location Service

eps Your Unit Pumper mming

inental-Emsco field representatives are ys eager to familiarize your operating per- el with the maintenance of C-E unit pers. They *know* these units. They can show people how to obtain efficient operating ls . . demonstrate counterbalancing . . and on well and equipment performances. n to rely upon your C-E man . . he'll help avoid trouble and in emergencies, prevent , prolonged shutdowns. His services ncrease production profits.

. . Proper Maintenance Can Mean Longer V-Belt Life, Too

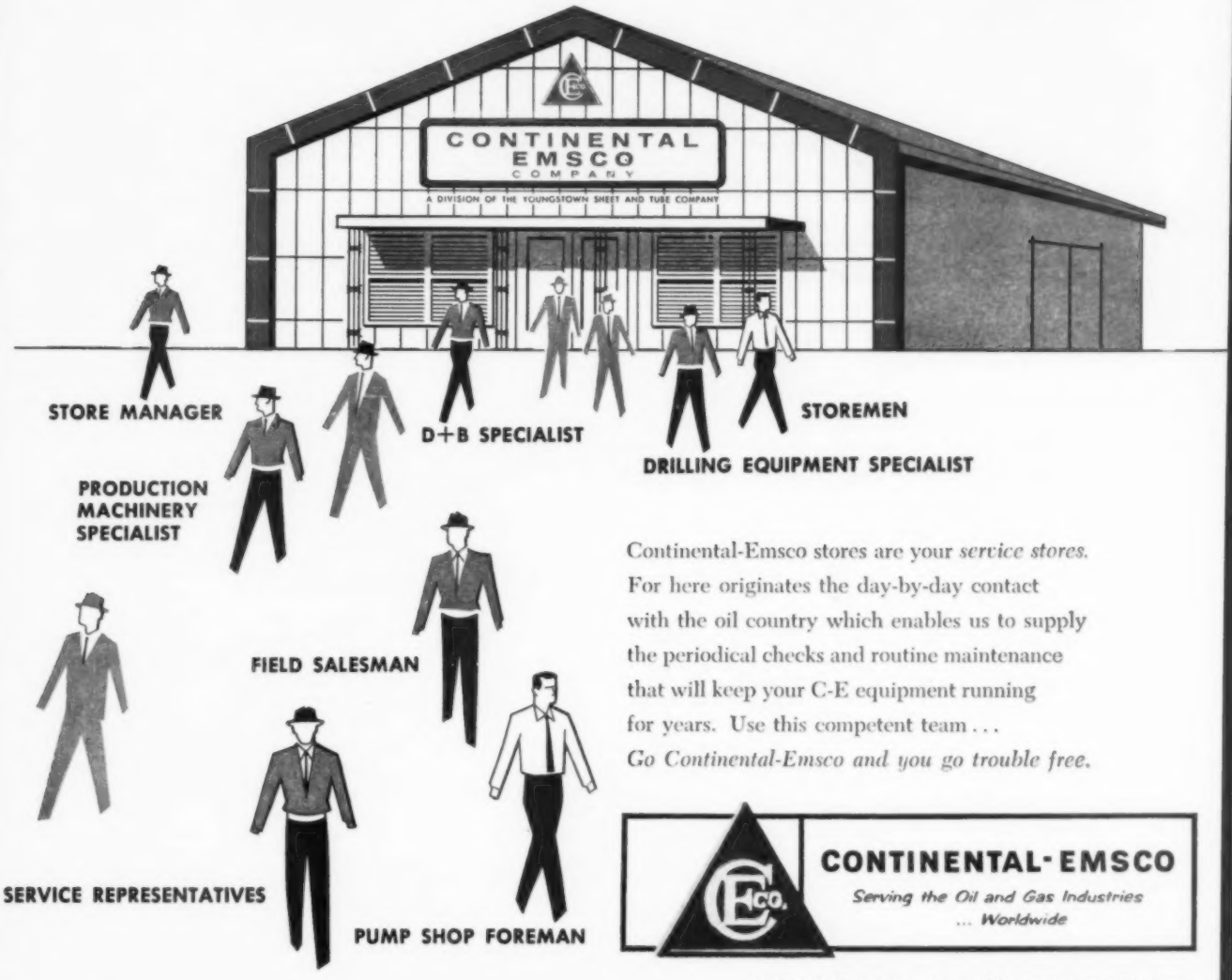
Correct V-belt tension extends the life of the belt and eliminates power-loss due to belt slippage. Your Continental-Emsco field representative will be glad to show you how to make these adjustments. Ask him, too, about GREEN TRIANGLE V-belts . . the belt designed, engineered and built exclusively for rugged oil field use by New York Belting and Packing Company, America's foremost producers of industrial rubber goods.

"V-Belt Guide for Pumping Units" will give many pointers on proper maintenance for V-belts. Write Continental-Emsco or get your personal copy from your Continental-Emsco representative.

t that Hums

ompson Tex.
L. Thornton Russell, Kans.
D. M. Thorwart Newcastle, Wyo.
K. Underwood Lindsay, Okla.
J. A. Upton Williston, S. Dak.
F. J. Viktorin Morgan City, La.
J. Weaks Houston, Tex.
H. D. Weaver Anaco, Venez.
R. L. Whelchel Lake Charles, La.
J. F. White Magnolia, Ark.
C. C. Williams Kilgore, Tex.

A Service Team to Keep Your Equipment Humming



Continental-Emsco stores are your *service stores.* For here originates the day-by-day contact with the oil country which enables us to supply the periodical checks and routine maintenance that will keep your C-E equipment running for years. Use this competent team . . . *Go Continental-Emsco and you go trouble free.*

CONTINENTAL-EMSCO

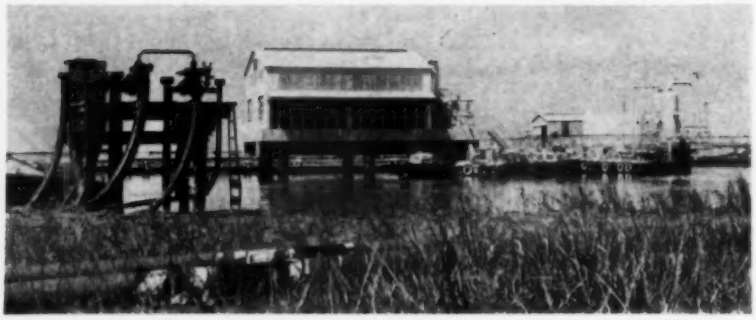
Serving the Oil and Gas Industries ... Worldwide

CONTINENTAL EMSCO COMPANY • A Division of The Youngstown Sheet and Tube Company
General Offices: Dallas, Texas • Export Division: 45 Rockefeller Plaza, New York, N. Y.
Continental-Emsco Company Limited • General Offices: Calgary, Alberta, Canada
Continental-Emsco Company C.A., Caracas, Venezuela • Plants: Los Angeles • Houston • Garland, Texas • Representatives in All Principal Oil Fields of the World

..Go CONTINENTAL-EMSCO

J. H. Williams, Oklahoma City, Okla. | K. N. Willis, Odessa, Tex. | W. C. Wilson, Houston, Tex. | B. G. Winters, Natchez, Miss. | R. L. Wishart, Jr., Ellinwood, Kans. | R. L. Wright, Borger, Tex. | W. L. Young, Wichita Falls, Tex. | Leroy Polk, McCamey, Tex.

2726R



Gas compresser station houses three 550-hp compressors which boost gas pressure to sales line pressure, and is supported by pre-stressed concrete structure. Platform at left supports transfer lines bringing production to terminal. At right are scrubbers to clean gas before entering compressors.

to handle 30,000 bbl of oil per day, but development of Blocks 24 and 27 has progressed so rapidly that additional tank storage has been added enabling the terminal to handle 50,000 bbl per day when the need arises. When first completed in September 1956, lease tankage capacity added up to 80,000 bbl and main storage tankage capacity amounted to 110,000 bbl. Now an additional 55,000-bbl main storage tank has been added, making a total tankage capacity at the central terminal of 245,000 bbl. Here's how tank capacity is broken down:

- Four 10,000-bbl capacity lease tanks,
- Two 20,000-bbl capacity lease tanks,
- Three 55,000-bbl capacity main storage tanks.

Other facilities provided at the central terminal include: Air conditioned living accommodations for 92 men; storage buildings; electric power generation and water distillation units; pipe racks; boat repair shop; seaplane ramp; boat fuel storage; gas compressor station; dehydration unit; heater-treater units; control stations for remote operation of both main storage facilities and lease measuring and storage installations, and an intercommunication system.

Since there are no telephone lines connecting this very remote terminal to headquarters in New Orleans and Westwego, all communications are handled by radio and radio-telephone.

Offshore Production Facilities

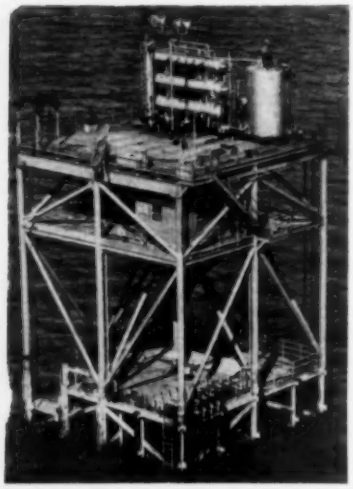
Block 24 field, Louisiana's biggest oil field to date, extends into the marshy swampland at its northern end and southward into the unprotected waters of the South Pass area between the forks of the Mississippi Delta formed by South Pass on the east and Southwest Pass on the west. At its southern extremity, open water reaches depths to about 15 ft. Block 27 field lies immediately to the south of Block 24, and is in Gulf water varying in depths from 20 to about 40 ft.

Offshore field development. Block 24 field was discovered by Shell in 1950 and was subsequently extended northward toward the Dixon Bay field consisting mainly of the marshland segment of the field. As of January 1, 1958, there were 207 producing wells in this field, having an allowable of 24,880 bbl per day. Flowing pressures range from 3000 psi to gas-lift flow. Generally, well depths range from 8200 to 8400 ft, although there are a few wells of shallower depth and a few much deeper.

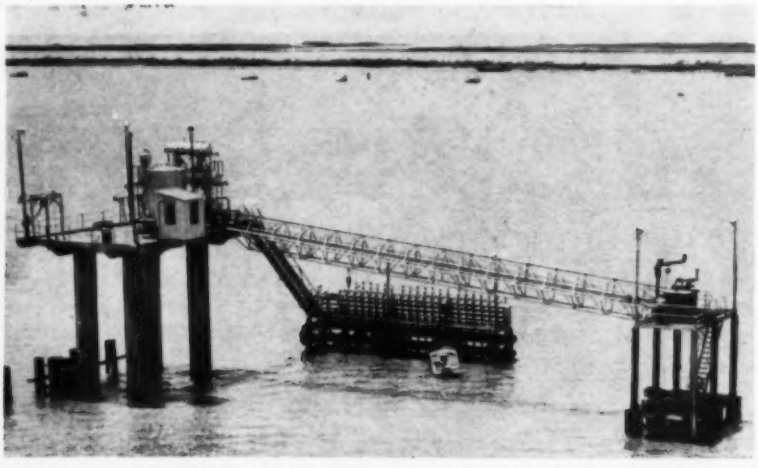
As of January 1, 1958, Block 27 field had 57 producing wells with an allowable of 6400 bbl per day. Well depths range from approximately 8000 to 8500 ft in this field. Flowing tubing pressure varies from 500 to 3500 psi.

Individual well structures. It is interesting to note that in each of these fields, most wells are drilled from single-well structures, although in a few instances twin-well structures have been used. Wells are drilled using mobile drilling barges and the platform type structure-drilling tender combination has not been employed in developing either field.

Wells situated in the marshes where the location was dredged out were equipped with conventional treated wooden piling-type structures. In the deeper waters of Block 24 and in Block 27, a four-pile steel structure was generally erected. In some instances, a 6-pile, 2-deck, step-up structure is used.



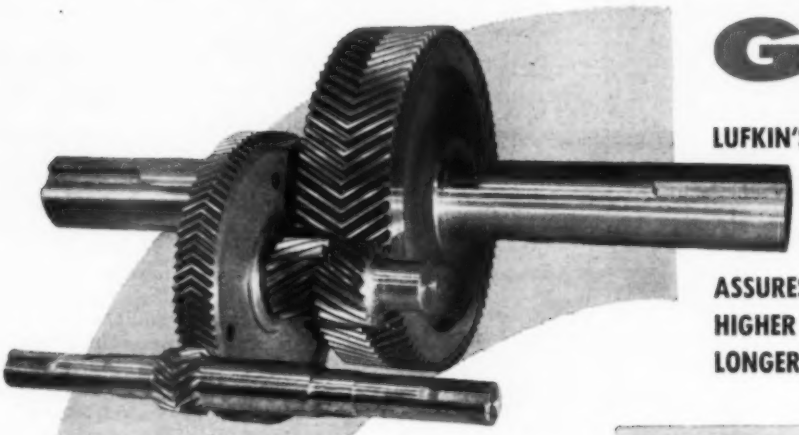
Production platform "L" in the Block 27 field. Water is 24 ft deep and the structure is designed to handle production from 30 wells.



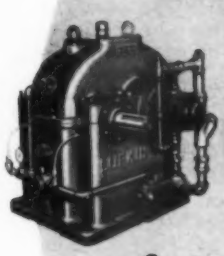
Production platform "G" in the shallow waters of Block 24 field. This four-pile structure is of pre-stressed concrete supporting separation and well test equipment. Lower platform at right contains gas engine driven pump and electrical power generator. Flow lines from 19 wells connect to header platform in center.

Insure QUIET, EFFICIENT AND UNINTERRUPTED Power Transmission

with LUFKIN precision GEARS



LUFKIN'S PRECISION IN DESIGN AND PRODUCTION AS WELL AS THE SELECTION OF FINEST MATERIALS AVAILABLE ASSURES SMOOTH, QUIET OPERATION, HIGHER LOAD CAPACITY, AND LONGER LIFE



SPEED INCREASERS

SPEED REDUCERS

PUMPING UNITS

"precision" means . . .

- CORRECT PROPORTIONS
- ACCURATE TOOTH SPACING
- EXACT HELIX ANGLE
- PERFECT TOOTH CONTOUR
- FINE SURFACE FINISH
- PROPER ALIGNMENT.

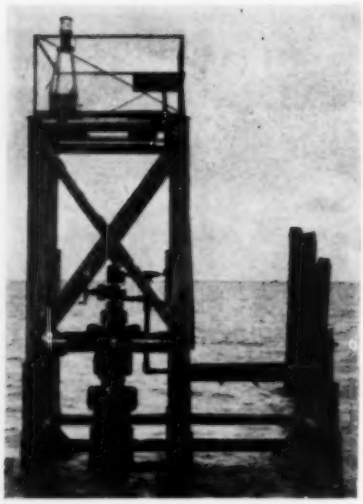
MEMBER OF AGMA

Lufkin FOUNDRY & MACHINE COMPANY

LUFKIN, TEXAS

Houston • Natchez • Corpus Christi • Lafayette • Dallas • Kilgore • Odessa • Hobbs • Farmington, N. M.
Midland • Pampa • Wichita Falls • Los Angeles • Bakersfield • Effingham • Casper • Denver • Sidney • Great Bend
Oklahoma City • Seminole • Tulsa • New York • Maracaibo, Venezuela • Shreveport

Lufkin equipment in Canada is handled by
THE LUFKIN MACHINE CO., LTD., 9950 65th Avenue, Edmonton, Alberta, Canada, Regina, Saskatchewan, Canada



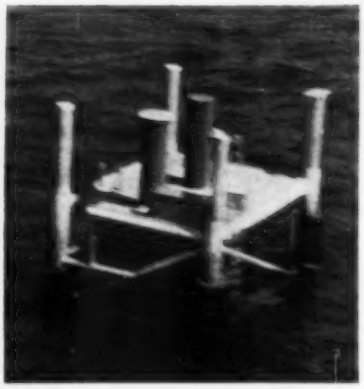
Typical one-well structure in Block 24 utilizing 6 piles 10¾ in. in diameter and about 70 ft long driven through a jacket. This type is used in 10 to 13 ft of water.

Production platforms. General system for handling production from individual wells is through 2000 to 2500 ft of 3 or 4-in. flow lines from the wells to a centrally-located production platform, where primary gas and liquid separation is achieved. Up to 30 wells can produce into these production platforms. Block 27 field now has six such platforms, while Block 24 utilizes 11 platforms. Production platform "A" in Block 24, being centrally located, is the junction point for gas and well fluid production from four other production platforms, and from this point, production is transferred to the central terminal on the banks of Southwest Pass.

In the marshes and very shallow water of Block 24, these production platforms are mostly of treated wooden piling. Platform "A", located in about 6 ft (mean gulf level) of water, consists of pre-stressed concrete piles and capped with a pre-stressed concrete deck. Beyond this depth, steel piles and steel jackets were employed in the construction of the platforms. In the deeper water of Block 27 field, the newer type production platform measures 40 ft by 40 ft, supported by 9 steel piles. It contains three separate decks. The lower deck, about 13 ft above mean gulf level, contains the flow line manifold; a second deck, nearly 40 ft above MGL, supports the electrical generating equipment, pumps (if required) and gager's shelter fully equipped for emergency uses. The top deck, supporting separation and testing equipment, is about 50 ft above MGL.

Production platforms are equipped with all facilities necessary for primary gas separation. In most cases there are four separation systems: 1000 psi, 500 psi, 80 psi, and test. The high-pressure (1000 psi) separator handles water-free oil, the intermediate pressure (500 psi) handles either water-free or wet oil, and the low-pressure (80 psi) separator generally handles wet oil. This is a flexible system and differs from platform to platform. The platforms also contain oil metering equipment for individual well testing and the liquid meters are calibrated periodically.

Production from individual well flow lines enters a four-way header of the platform. Here manifold and valve arrangement makes it possible to direct the flow into one of four systems: (1) High-Pressure water-free oil system; (2) intermediate pressure water-free or wet oil system; (3) low-pressure "wet" oil system and (4) well testing system.



Typical 4-pile well structure under construction in Block 27 where water is about 39 ft deep. Steel piles were driven through jacket. The jacket pictured here has been equipped so that two wells can be drilled from the location.

Production from high-pressure wells producing water-free oil goes to the high-pressure vessels for primary separation at about 1000 psi. Gas goes into the high-pressure gas system; the oil enters the water-free oil system for transfer to lease storage at the central terminal. Intermediate pressure water-free or wet oil wells are handled by a second separator operating at about 500 psi. Gas goes into the intermediate pressure gas system while oil goes into the water-free or the wet oil transfer line. Considerable gas is still present in the oil after passing through the high pressure and intermediate pressure separators.

To be marketable, the oil must be processed through second stage separator units just before going to lease storage. Wells producing both oil and water go into a third separator set at 500 psi, or at lowest well flowing pressure. Produced fluid (oil and water) discharges into a wet oil line, and gas goes into the intermediate pressure gas line. A fourth separator is used for test purposes.

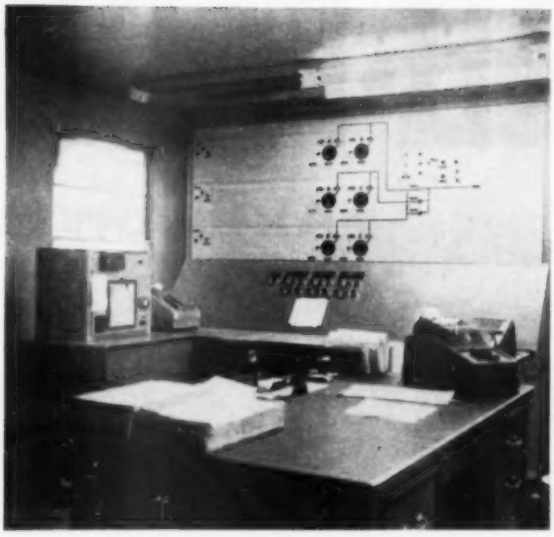
The individual well test section contains meters, samplers, surge tanks and, after measurement, the oil is pumped into either the "wet" or "water-free" oil lines from the surge tank. Gas-oil ratios, API gravity of the oil, water percentages and the quantity of oil produced during the test period are determined. In Block 24, some stations consist of three separate platforms: (1) Well header platform near water level; (2) concrete production platform with separation and testing equipment, and (3) a separate platform for pumps and electric power generators driven by gas engines. The pump platform is connected to the production platform by a 100-ft walkway and at a lower level than the platform supporting the separation and testing equipment. This provides the pump on the lower platform with a flooded suction. On the three-deck platforms, utilized in the Block 27 field where the water is deeper, the pump, generator and personnel shelter are located on the second deck separated from the separation and test equipment on top by a solid steel upper deck. A 7 by 10-in. oil pump is driven by a 130-hp gas fueled engine. A steam-type reciprocating pump that will operate on gas pressure also is included for emergency uses. Should the gas engine pump shut down, the standby gas-pressure powered pump will automatically start up.

Flow lines. Flow lines from individual wells to production platforms are 3 and 4-in. lines; from the individual platforms to the major transfer lines, 4 and 6-in. lines are used. Major transfer lines are usually of 8-in. pipe. From platform "B", in Block 24, a combination 10 and 12-in. transfer line carries production to the central terminal facilities ashore. Lines laid in the marshes and in water are protected against corrosion by a semi-plasticized coal tar enamel and fiberglass wrap. Coating is applied at a pipe yard. All coatings and field joints were inspected by a holiday detector. Submerged gas pipe lines 6-in. in diameter and larger were coated with concrete, applied at the pipe yards. Joints made in the field were coated on the laying barges.

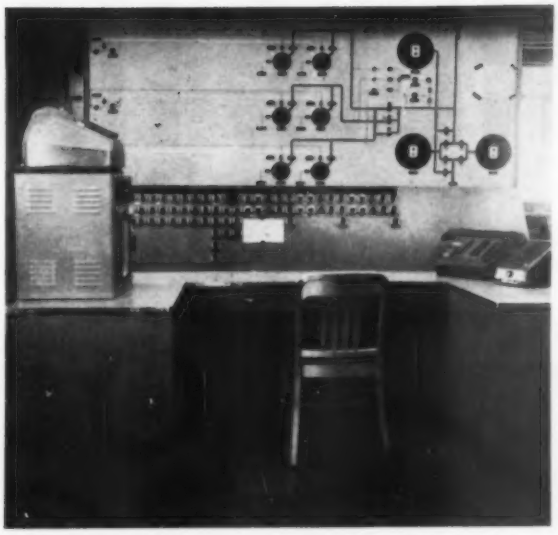
FOUR PRIMARY FIELD SYSTEMS

Water-free oil. Production facilities serving Block 24 and Block 27 fields include four primary systems for transfer of production to shore based treating and storage facilities. Perhaps the largest flow system is that for "water-

Oklahoma City • Seminole • Tulsa • New York • Maracaibo, Venezuela • Shreveport
Lufkin equipment in Canada is handled by
THE LUFKIN MACHINE CO., LTD., 9950 65th Avenue, Edmonton, Alberta, Canada, Regina, Saskatchewan, Canada



Central control panel to supervise and control production facilities at the central terminal. Note schematic flow diagram and console.



Central control station operated by Shell's oil shipping division. The three large circles on the simulated flow diagram represent 55,000-bbl storage tanks. Oil can be remotely tested, measured and transferred from this point, and all data printed on tape for permanent records.

free" oil, containing little basic sediment and water. The water-free oil line from Block 24 generally is an 8-in. line, except from "B" platform to the terminal which section includes a combination of 10 and 12-in. line. The water-free oil system from Block 27 is an 8-in. line which carries production to bulk separators, from which it flows to the lease storage tanks. Field separators operate at about 1000 and 500 psi, while the bulk separators at the central terminal, which are necessary to remove entrained gas and put the oil in a marketable condition, maintain a back pressure at about 40 psi which is sufficient to flow the oil on into lease storage tanks for measurement.

Wet oil. An 8-in. wet oil line serves Block 24, and a 6-in. line carries "wet" oil from Block 27 to the central terminal. In most cases, separation pressure will carry oil to the central terminal where it flows through heater-treaters operating at about 35 psi. At several production platforms, well characteristics require operation of the wet oil separators at low pressure and the fluid must be pumped into the wet oil lines. The treating facilities at the central terminal provide final separation of oil and water before movement of the oil to lease storage.

Gas system. Between 30 and 35 million cu ft of gas per day flow into Tennessee Gas Transmission Company's Muskrat Line serving the lower Delta area. There are two separate gas transfer lines bringing gas into the central terminal facilities. High-pressure lines, of 4 and 6-in. in diameter, carry gas discharged from separators operating at about 1000 psi. This high-pressure gas passes through a dry dessicant type dehydrator at the central terminal before measurement and transfer into TGT's line.

Intermediate pressure gas comes from separators located in the field on production platforms. These separators discharge the gas at about 500 psi. Since this is not sufficient pressure to enter the high-pressure sales line, the intermediate pressure gas first goes through a scrubber and then is compressed at the central terminal before going through the dehydrator, meters, and into the sales line.

As wells decline in pressure and require gas lift to obtain production, a system for handling low-pressure gas will be required.

SHELL'S MULTI-MILLION DOLLAR TERMINAL

Design and construction of this giant terminal was an engineering accomplishment. Perhaps the major construction problem was the jelly-like marshland that offered little foundation support. Not only was it necessary to fill in the 26-acre site to a height of 4 ft above mean gulf level, but foundations had to be supported by piling. Construction began in January 1956, and the terminal was placed in operation in September 1956.

Since Shell maintains large supply centers at Harvey and Venice, Louisiana, the end of the road down the Mississippi Delta, there was no need to make provisions for complete field warehousing facilities. Some storage, however, was provided for tubular goods and other supplies used in the maintenance of both fields. Five air conditioned, galvanized, steel living quarters were skid mounted and placed on 24-in. steel pipe piling at 12 ft above MGL.

All facilities, including mess hall, recreation room and living quarters are provided for 92 men. Normal complement of company personnel occupying these quarters is about 75 men, with quarters also available for oilfield service personnel.

Other auxiliary facilities at the cen-

Oil sample catcher in main transfer line from lease tanks to main storage tanks.

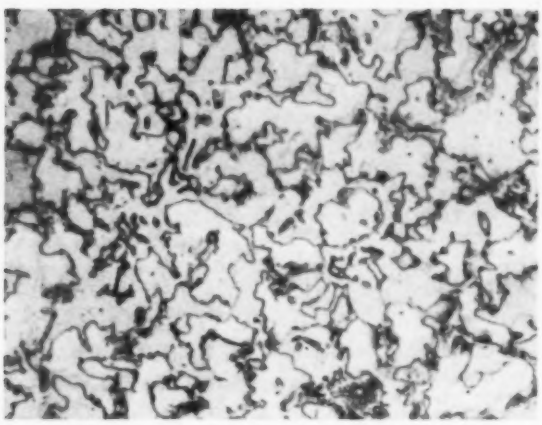
NEW HARD-FACED

Axelson cuts

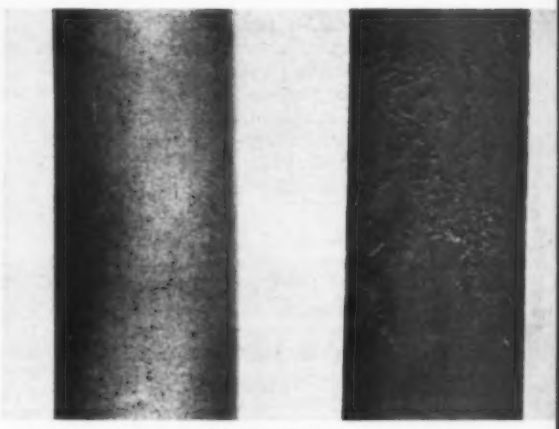
AXITE PLUNGER

down-time 3 ways

- **HIGHLY RESISTANT TO ABRASION**
- **RESISTANT TO CORROSION**
- **NON-GALLING**



DIAMONDS have a hardness of 10 on the Mohs scale. The new Axite plunger has a hardness of 9. Detail above (magnified 500 times) shows a completely integrated metal surface. Carbide and boride particles – dispersed throughout the alloy – are four times harder than Rockwell "C" 62 reading indicates.



HIGH SURFACE RESISTANCE to corrosion is demonstrated in this comparative photo. After seven days of submersion in a concentrated hydrogen sulfide solution, Axite plunger remains clean and smooth while plunger made of other material shows deep pitting. When I. D. and pin face are nickel-plated, the Axite plunger is virtually impervious to all forms of corrosion.

IT'S A PROVEN FACT – AXITE PLUNGERS LAST LONGER, WEAR LONGER.

Write for the new Axite Brochure.

AXELSON

There is no economical substitute for quality.

AXELSON MANUFACTURING COMPANY

Division of U. S. Industries, Inc.
6160 So. Boyle Avenue, Los Angeles 58, Calif.

Since 1898
products designed to give oil a lift

AXELSON PRODUCTS ARE DISTRIBUTED EVERYWHERE

CALIFORNIA: Axelson Sales and Service Stores in all principal California fields
Hickey Pipe and Supply Co., (sucker rods), Los Angeles, Coalinga

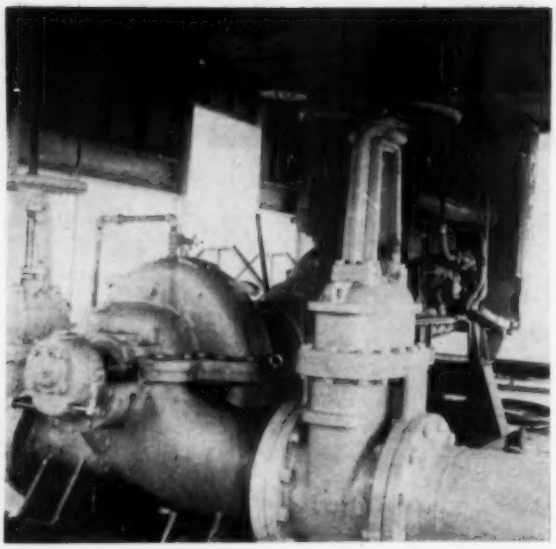
MID-CONTINENT AND EASTERN: Jones and Laughlin Steel Corp., Supply Division, Tulsa

ROCKY MOUNTAIN: Jones and Laughlin Steel Corp., Supply Division, Tulsa
Great Northern Tool and Supply Co., Billings

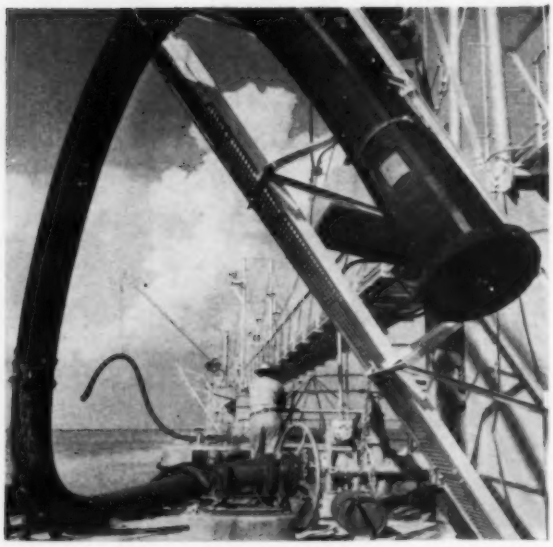
CANADA: Jones and Laughlin Steel Sales Co., Ltd., Supply Division, Calgary
Dominion Oil Fields Supply Co., Ltd., Calgary

FOREIGN: Represented in all major oil-producing areas.

© 1958—Axelson Manufacturing Company, Div. of U. S. Industries, Inc.



Centrifugal pump station used by oil shipping division to transfer oil from main storage to oil barges. It is remotely controlled and can pump up to 8000 bbl per hour.



Barge loading dock, one of the most modern anywhere, is over 850 ft long and can dock, load, and release two 25,000-bbl barges in about 7 hours.

tral terminal include fuel storage for boats, pipe racks, warehouse, water distillation and electric power generation units, boat docks, floating boat landing, seaplane ramp and boat repair shop. The remainder of the terminal involves facilities for handling oil and gas production from Block 24 and Block 27 fields.

Production facilities. Oil shipping and oil handling facilities at Shell's central terminal are separate. Shell's oil shipping division maintains and operates the main storage and oil shipping facilities. Shell's Delta production division maintains and operates all other facilities including the gas compressor station, heater-treater battery, and lease tankage facilities. The latter are divided into three separate accounts:

1. Two 10,000-bbl tanks for Block 27 oil.
2. Two 20,000-bbl tanks for oil produced from wells located in the water portion of Block 24.
3. Two 10,000-bbl tanks for oil produced from Block 24 wells located in the marshes.

As described, there are two types of oil flowing into the central terminal: (1) Water-free oil and (2) wet oil. Oil flowing through the wet oil field transfer system goes through the heater-treaters before flowing into the lease tanks. Water-free oil from the field transfer line flows through separators to remove entrained gas and then goes directly into the lease tanks. All gas production is handled separately. High-pressure gas goes through a dehydrator, meters, and into the sales line. Intermediate pressure gas goes through scrubbers, then is compressed from about 500 to 1000 psi, then through the dehydrator, meters, and into the sales line.

The compressor station was installed on a prefabricated platform of pre-stressed concrete supported by hollow cylindrical pre-stressed concrete piles. Gas is compressed by three 550-hp packaged compressors. The gas dehydrator is a twin tower unit with a capacity of 30 million cu ft of gas per day. It is also a packaged unit, equipped to switch the flow of gas from one tower to another when the dessicant beds in one tower become saturated with moisture. The saturated bed is then regenerated while flow is through the other tower.

Oil production flowing into the central lease storage is handled by remote controls located in the production division's central control station. This system is similar to but is separate from the control system employed by the oil shipping division. In the production division's control station is located the instrumentation and controls for the remote control of oil flowing into the lease tanks.

The production operator utilizes switches on the control panel to open and close lease tank inlet valves and start and stop the tank bottom treating system pump. Oil entering any of the lease tanks is automatically and continuously tested for bs&w content. These bs&w indicator units are adjusted to sound an alarm whenever the bs&w content exceeds one percent. Instrumentation is described later.

Oil Shipping Facilities

The oil shipping division's facilities include three transfer pumps, three 55,000-bbl main storage tanks, testing equipment, central control facilities, a barge loading pump, an 850-ft ultra-modern barge loading dock, and fire fighting system.

When a lease tank is filled and ready for transfer to the main storage tanks, the procedure can be handled by remote control from the oil shipping division's central control station. As mentioned, in this control station are located the instrumentation and controls to permit the remote control and measurement of oil transferred from the lease tanks to main storage.

Testing instruments have been installed on an experimental basis to carry out the following functions. Bottom sample lines are connected to each lease tank and a sample can be taken and tested automatically. This operation is controlled remotely from the control station. The sample goes to the bs&w monitor for testing prior to the transferring of the contents of any lease tank to main storage. Oil level in the lease tanks and temperature of the oil in any tank can be taken and lease tank discharge valves can be opened and closed remotely. Also, bs&w content and API gravity of a tank run to main storage can be taken remotely by automatic sampler and testing equipment.

The three transfer pumps, each having a capacity of 1500 bbl per hour, are remotely operated from this control station. Oil may thus be transferred from the lease tanks to main storage at the rate of 4500 bbl per hour.

© 1958—Axelson Manufacturing Company, Div. of U. S. Industries, Inc.

A TYPE AND SIZE STRUCTURE FOR EVERY DRILLING REQUIREMENT

Lee C. Moore design engineers maintain a constant program of study and research to provide a world-wide oil industry with structures best suited to specific requirements.

CANTILEVER MASTS • TRAILER MOUNTED MASTS
DERRICKS • SUBSTRUCTURES • SAFETY PLATFORMS
STAIRWAYS • RAMPS • PIPE RACKS • ENGINE
FOUNDATIONS • STEEL FLOOR GRATINGS

LEE C. Moore CORPORATION

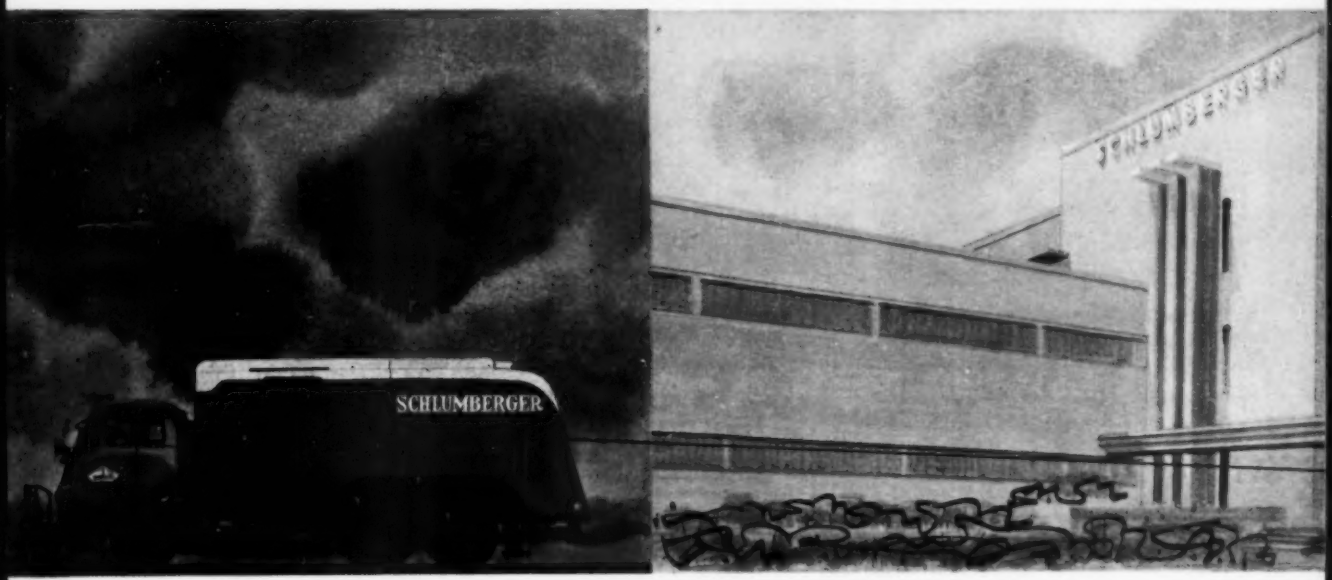
TULSA : DALLAS : HOUSTON : CENTRALIA : ODESSA
NEW ORLEANS : CASPER : GREAT BEND : PITTSBURGH

EXPORT OFFICE: ROOM 626, INTERNATIONAL BLDG., 630 5TH AVE., NEW YORK 20, NEW YORK
FOREIGN LICENSED MFR.: OIL WELL ENGINEERING CO., LTD., CHEADLE HEATH, STOCKPORT, ENGLAND

the most surveyed well in the world is right in Schlumberger's "backyard"

It is our specially constructed test well, completed in 1948. Since then, more than 6500 test surveys have been run . . . more than two-a-day every day of the year.

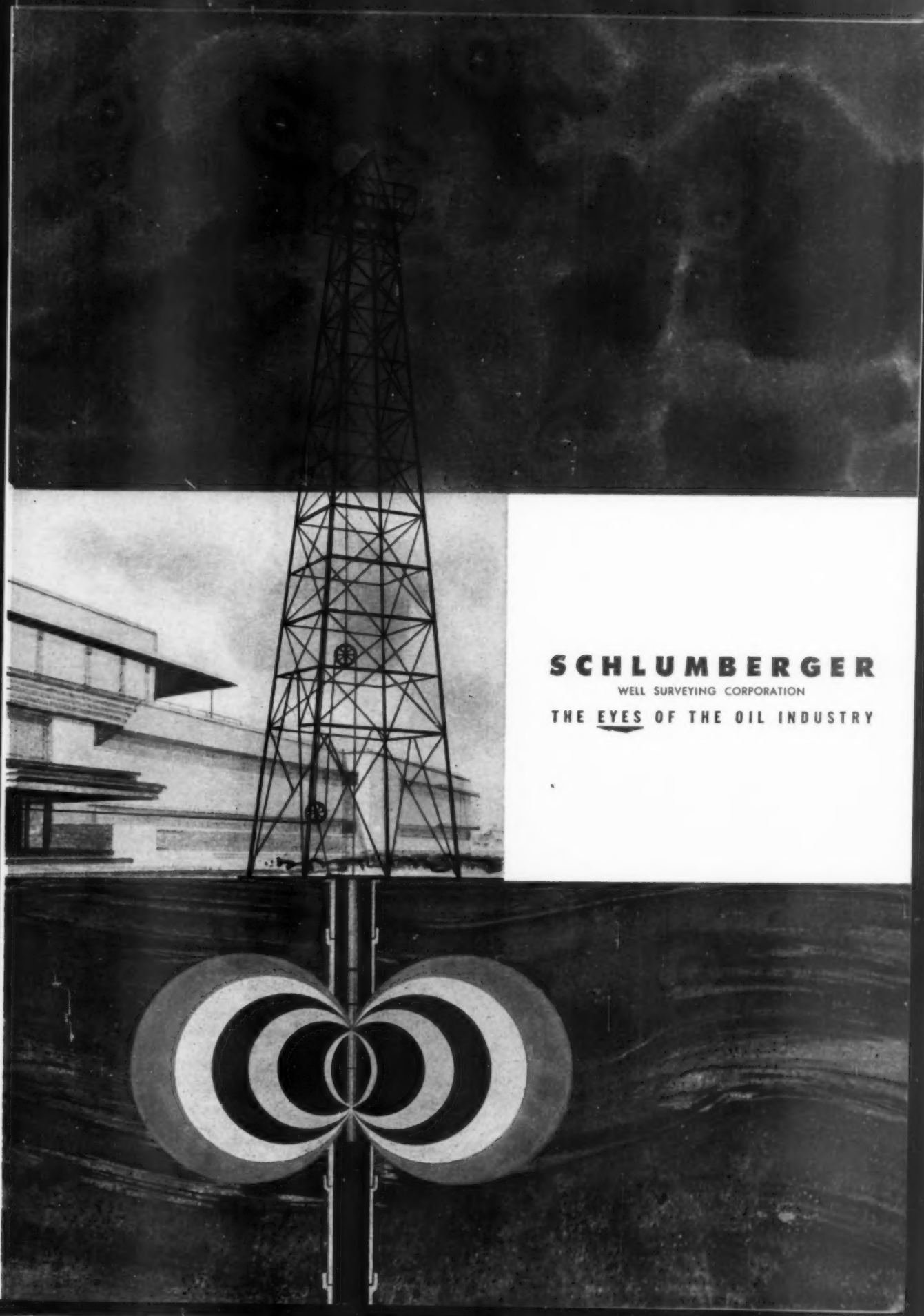
Nearly 800 complete Schlumberger Field and Off-shore Units have logged time at this test well in the past 9 years. It is specially constructed so that the test engineer can run actual down-the-hole surveys. Thorough check-outs are given every Schlumberger instrument control panel and recorder. This has involved the logging of more than 5,200,000 feet of hole.



In combination with this test well and other field simulated conditions in our laboratories, every Schlumberger Field Unit has proved its accuracy and dependability before it rolls up to your well.

The purpose of this exhaustive pre-field testing program, of course, is to insure the very highest quality field performance . . . Schlumberger quality . . . from the very beginning.

Schlumberger...to be sure!


SCHLUMBERGER
WELL SURVEYING CORPORATION
THE EYES OF THE OIL INDUSTRY

REDA
PUMPS
FIRST CHOICE
FOR SECONDARY RECOVERY WATER FLOODING . . .
because pumping with REDA lowers costs and INCREASES PROFITS!
HERE'S HOW:
• Large water volume obtained from smaller size well casings reducing number of supply wells necessary
• Flexibility of Reda Pumps in meeting changing water requirements common to most waterflooding projects
• Easier, less expensive installation and lower maintenance costs
• Low operating costs and long operating life of Reda equipment
• Corrosion resistance of Reda pumps is superior to any other pumping unit used in supply wells
Reda Submergible Pumps are a major factor in the success of waterflooding and pressure maintenance operations. They are being used in major floods with very successful results of increased production and lowered costs.
Write for complete information today! Reda engineers will be pleased to call and assist in planning operations.
SIGN OF QUALITY . . .
SUBMERGIBLE REDA PUMPS
REDA
PUMP COMPANY
BARTLESVILLE, OKLA.

Foundations for the 55,000-bbl tanks posed one of the difficult construction problems. Each main storage tank required 708 untreated wooden piles 55 ft long. On top of these piles was placed an 8-in. reinforced concrete slab. A 5-ft reinforced concrete wall 12 in. thick was poured around the periphery of each slab. This circular concrete pit was then filled with sand and the tank erected on this foundation. The ring wall supports the tank shell which is held to the concrete foundation by 72 1¼-in. tie-down bolts. Each tank is encircled by a fire wall.

The barge loading dock is modern and is unique in design. Located on the east side of Southwest Pass, it is over 850 ft long. It consists of eight 19-ft diameter cells extending 40 ft into the mud and sand. The cell is made of interlocking steel sheet piling filled with sand and capped with concrete. All cells are connected by a steel suspension type walkway bridge. There are three 140-ft spans (center and both end spans) and four 108-ft spans elevated above the water to clear any light barge which might drift underneath.

The two center cells form the two barge loading points and are connected to shore by a Y-shaped steel-walkway carrying 10-in. oil loading lines. These lines connect to headers supported by the walkway bridge and feed oil into barge loading hoses. The center cells are equipped with counterbalanced gangplanks, an electrically powered hose handling boom, and a hand-operated utility winch.

Each end cell contains a hand-operated mooring winch. This dock will easily accommodate two 25,000-bbl capacity oil barges which can be docked, loaded and put under tow in a matter of about seven hours. Oil can be pumped from main storage into barges at the rate of 8000 bbl per hour by a heavy-duty centrifugal pump powered by a 200-hp gas engine. Filling operation is controlled by remote switches from the dock.

Instrumentation. The production division's and the oil shipping division's central control stations are similar to those found in the control rooms of modern refinery and pipeline pump stations. The receiver console and instruments control remotely the functions pertinent to each individual control center and, in addition, make possible for certain information to be obtained remotely at either control point. Both control stations have indicator panels which show schematically a diagram of the flow system. A number of lights indicate the various functions, valving, and tests. Data can be obtained by dialing the required information concerning any location and this information is visually indicated and is recorded on tape. This system will interpret and record an almost infinite number of values for four primary items: (1) Oil level and (2) temperature of the oil, in any of the six lease tanks and in any of the three main storage tanks; (3) bs&w content and (4) API gravity of the samples taken from lease tank oil as it is transferred to main storage. The system is based on a modification by the Shell Development Company of Emeryville, California, utilizing commercial pulse code equipment for the various functions.

If either control station operator desires any of the four items of information listed above, all he needs to do is to ask for it. This request is made by dialing the code for the location and type of data required on a dial similar to a common telephone. Information is telemetered to a visual system of columnar numbers for direct reading and is recorded on tape to form a permanent record. The system has been designed to permit the future addition of equipment by which the information may be transmitted and typed out on a similar tape at the New Orleans headquarters.

The automatic instrumentation and testing equipment incorporated in the design of this terminal is at present undergoing calibration and adjustment, and, upon achieving accuracy and reliability comparable to hand gaging methods, and acceptance by all interested parties, consideration will then be given to placing this system in routine operation.

Future of installation. Extreme flexibility has been designed into Shell's central terminal facilities as far as concerns production and automation. Its size can be further increased as field development grows. The automatic control system makes it possible for the complete operation to be controlled and supervised completely and remotely by the two control stations.

Equipment has been designed so that all data can be telemetered into New Orleans for automatic record handling. The entire facility, from the individual field wells to barge loading, has been engineered for maximum efficiency and resultant lowering of production costs. It is a big step toward making offshore production pay and undoubtedly will serve as an example of an optimum method to economically handle offshore production.

Acknowledgment

The author is grateful to Shell Oil Company for permission to obtain and publish these findings, and to the New Orleans area engineers, the Delta production division and the oil shipping division for data and photographs used in this report. ★ ★ ★

Puerto Rico Eases Leasing Regulations

Puerto Rico has announced changes in its oil and gas regulations designed to spur exploration and drilling in the island. The self governing Commonwealth has attracted a $40 million oil refining industry in the past two years.

The type of rock and the thickness found along Puerto Rico's north and south coastal basins have led U. S. government geologists to conclude that the island may contain oil and gas deposits.

Major changes in Puerto Rico's oil exploration and drilling regulations are:

- Extension of exclusive prospecting permits from 3 to a maximum of 10 years.
- Extension of lease periods from 20 to 40 years for a maximum of 70 years with renewals.
- Elimination of the checkerboard 64 hectare lease block system.
- Instead, the size of lease blocks has been increased to 1344 hectares (approximately 3360 acres). Lease blocks must be separated from one another by a minimum of 6000 ft.

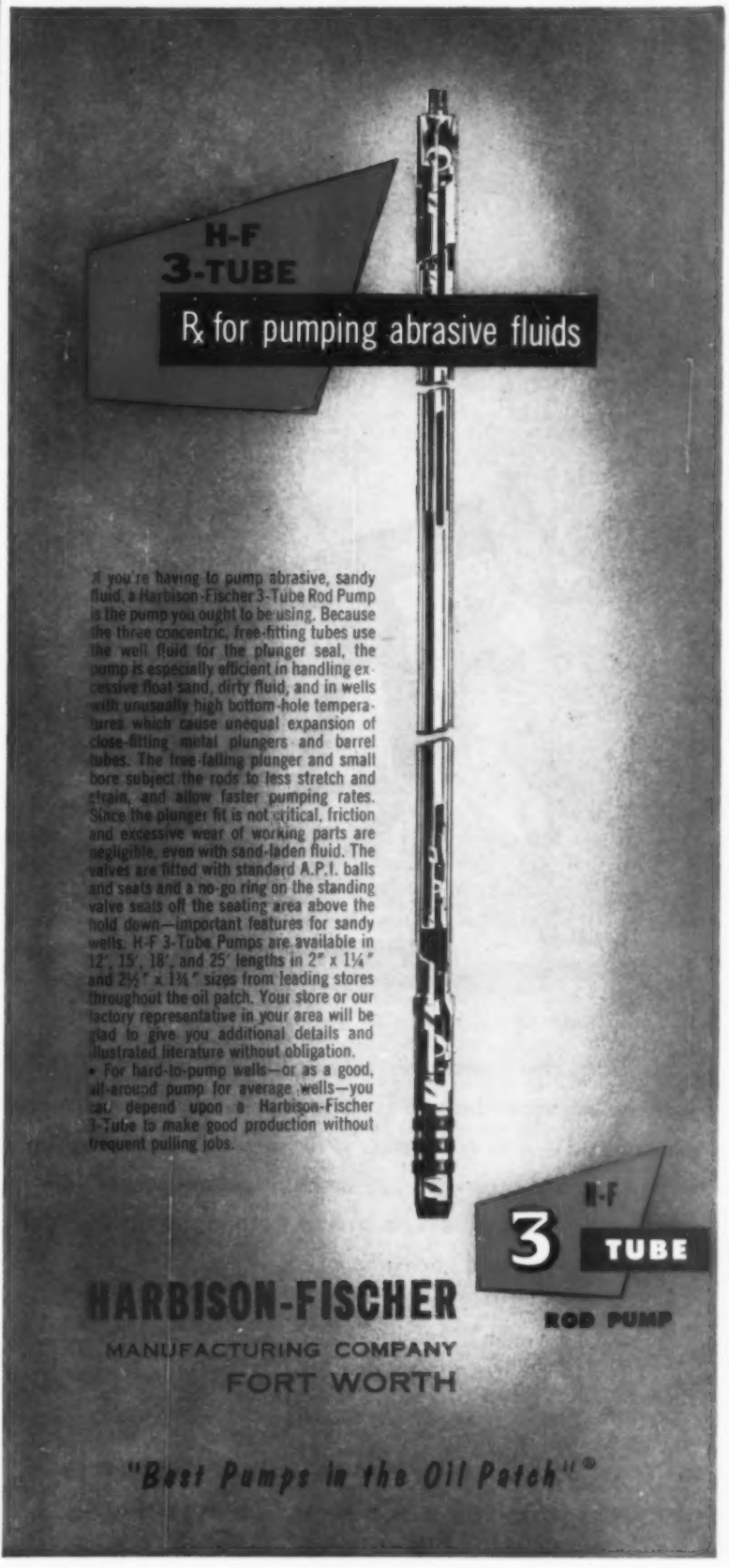
Puerto Rico permits all types of exploration, including seismic. A fee of $10 and a $10,000 bond are required for prospecting. Drilling is not permitted without a lease. Leases require a returnable application fee of $50 and rental at the rate of $20 per drilling unit (16 hectares) for the first year and $40 per unit each year thereafter. A $100,000 drilling bond is required.

Oil and gas producers are eligible for incentives offered under "Operation Bootstrap," Puerto Rico's industrialization program, including exemption from local taxes. Since Puerto Rico is outside the federal tax area, federal taxes do not apply. Production could be freely marketed in the U. S. as well as on the island, since Puerto Rico has free access to U. S. markets, without tariff or import restrictions.

Under Commonwealth law, the people of Puerto Rico retain ownership of any hydrocarbons that might be found to exist. In the event of an oil find, the lessee would be required to pay royalties in the island government, ranging from 5 to 16⅔ percent.

Puerto Rico has one of the highest per capita consumptions of petroleum in Latin America. Two modern refineries have opened there since 1955.

Detailed information regarding newly amended regulations and procedures can be obtained by writing directly to the Executive Secretary, Puerto Rico Mining Commission, Box 38, Roosevelt, Puerto Rico.


H-F
3-TUBE
Rx for pumping abrasive fluids
If you're having to pump abrasive, sandy fluid, a Harbison-Fischer 3-Tube Rod Pump is the pump you ought to be using. Because the three concentric, free-fitting tubes use the well fluid for the plunger seal, the pump is especially efficient in handling excessive float sand, dirty fluid, and in wells with unusually high bottom-hole temperatures which cause unequal expansion of close-fitting metal plungers and barrel tubes. The free-falling plunger and small bore subject the rods to less stretch and strain, and allow faster pumping rates. Since the plunger fit is not critical, friction and excessive wear of working parts are negligible, even with sand-laden fluid. The valves are fitted with standard A.P.I. balls and seats and a no-go ring on the standing valve seats off the seating area above the hold down—important features for sandy wells. H-F 3-Tube Pumps are available in 12', 15', 18', and 25' lengths in 2" x 1¼" and 2½" x 1¾" sizes from leading stores throughout the oil patch. Your store or our factory representative in your area will be glad to give you additional details and illustrated literature without obligation.
• For hard-to-pump wells—or as a good, all-around pump for average wells—you can depend upon a Harbison-Fischer 3-Tube to make good production without frequent pulling jobs.
H-F
3
TUBE
ROD PUMP
HARBISON-FISCHER
MANUFACTURING COMPANY
FORT WORTH
"Best Pumps in the Oil Patch"®

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Cabot pumping units have a lower initial price than their quality would signify, because they are stripped of frills. Because of this quality in workmanship and materials and because of strategically located factory owned repair shops, Cabot units have unusually low maintenance and repair bills. This, plus a record of field stamina and long life, makes Cabot pumping unit cost low.

OIL FIELD PUMPING EQUIPMENT
CABOT
SHOPS
PAMPA, TEXAS
FRANKS
DIVISION OF CABOT

- **Your J & L Supply man will be happy to discuss Cabot's pumping unit line with you.**

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

To meet future drilling and production requirements . . .

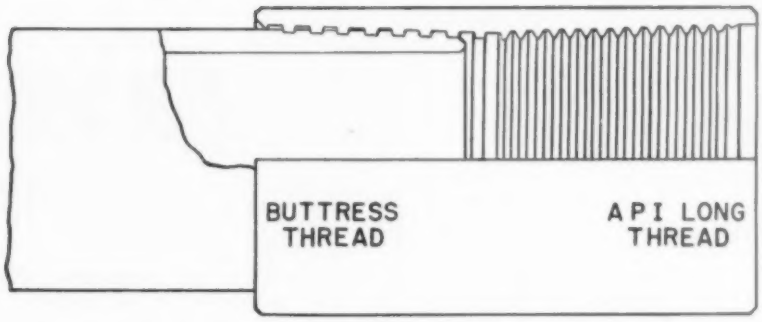


FIG. 1. **A cross-over type coupling** for casing with the new buttress thread and the conventional API long thread has added materially to the joint strength.

What's Ahead in High Strength Tubular Goods

New grade of drill pipe with minimum yield strength of 135,000 psi under test; a new grade of casing, X-200, with a minimum yield of 200,000 psi, now under development

A. B. Wilder,
Chief Metallurgist,
National Tube Division,
United States Steel Corporation,
Pittsburgh, Pennsylvania

DEVELOPMENT of higher strength seamless pipe has been closely associated with the drilling and production requirements of the oil industry. Grade N-80 casing became a standard in 1939, and Grade P-110 was adopted by API in 1955. In 1954, it was evident, from the greater depth of drilled holes and the higher bottom-hole pressures encountered, that a higher strength seamless casing, Grade V-150 (150,000 psi minimum yield strength), was required. This would provide the necessary annular clearance, collapse and bursting strength and sufficient joint tensile strength. After producing Grade V-150 casing, it became evident, in 1956, that a still higher grade of material would be required, particularly for turned down couplings (couplings with a lighter wall). This new grade of material, X-200 (minimum yield strength of 200,000 psi) is being developed.

In the production of quenched and tempered material, among the first considerations are the chemical composition and steel melting practice. In the heat treating operation, for example with casing, it is important to control straightness and out-of-roundness in order to maintain a high level of collapse strength in the finished product. After heat treatment of the material, various inspection techniques, such as magnetic particle inspection are used in controlling the surface quality of the product, including the detection of quench cracks. Magnetic particle inspection and certain other practices are not part of a specification requirement.

EDITOR'S NOTE: This brief introduction to higher strength seamless pipe was extracted from a discussion by the author given at the general meeting of the American Iron and Steel Institute in New York City in May 1957.

TABLE 1. Minimum Ultimate Joint Strength of Grades P-110 and V-150 Casing.

Size OD-in.	Nominal wgt/ft	Wall in.	Steel grade	Minimum ultimate joint strength: API long thread joint 1000 psi	Minimum ultimate joint strength: Buttress thread joint 1000 psi
5½	20	.361	P-110	500	742
5½	23	.415	P-110	576	845
5½	20	.361	V-150	565	903
5½	23	.415	V-150	646	903
7	29	.408	P-110	681	1060
7	32	.453	P-110	756	1169
7	29	.408	V-150	810	1304
7	32	.453	V-150	900	1357

TABLE 2. Chemical Analysis of P-105 Grade Tubing.

Grade	C	Mn	Si	Ni	Cr	Mo	V
4340	.40	.70	.25	1.80	.80	.25	
Mn-Mo-V	.40	1.50	.25			.50	.06
Mn-Ni-Cr-Mo-V	.40	1.45	.25	.50	.50	.25	.06

but are manufacturing practices directed at maintaining a high level of quality in the finished product.

Buttress casing thread. An important development, applicable to quenched and tempered casing, is the buttress thread shown in Fig. 1. This type of thread eliminates the necessity for upsetting the ends of casing to increase the joint strength. A comparison of the strength properties of the buttress thread and API thread is shown in Table 1. Strength properties are usually determined in a 600-ton-capacity tensile testing machine. A 2000-ton-capacity machine, however, is used for the V-150 grade casing. The production of couplings or integral joints for oil country tubular products from high strength materials is an important consideration. This is due to the type of stress in couplings compared with pipe.

Grade V-150 casing. In addition to the production of deep well P-110 grade high strength casing, a new super-deep well V-150 grade casing (150,000 psi minimum yield strength) has been produced. This material was first used in 1955 in the world's deepest hole, which is a producing well.

Grade V-150 casing is in the development and field testing stage. The chemical composition and manufacturing practices have not been standardized. A typical casing combination string for a 22,000-ft well with P-110 and V-150 material and T&C buttress and API long thread couplings is shown in Fig. 2. (See page B-100.)

Material with 200,000 psi minimum yield strength is also being developed, particularly for special clearance couplings. The collapse strength curves for the API and V-150 grades of casing are shown in Fig. 3. (See page B-100.)

X-135 drill pipe. High strength drill pipe will be required in the future. The present API Grade E drill pipe has a minimum yield strength of 75,000 psi and is produced by the normalize and temper method. Drill pipe with 110,000 psi minimum yield strength has been produced and used in the field, but this grade has been abandoned in favor of a new grade with 135,000 psi minimum yield strength. This higher strength material, in the development and field testing stage, is produced by the quench and temper method, and a string of X-135 drill pipe is already in service in the field.

One interesting problem in connection with high strength drill pipe is the attachment of tool joints to the upset end of the drill pipe. The tool joints are either threaded or flash welded to the drill pipe and serve as a connection for making and breaking the drill stem in the field. For flash welding, a special upset is used. After welding, the flash welded area is normalized and tempered.

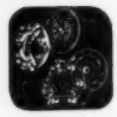
Higher strength tubing. Experience has indicated oil well tubing may be produced by the quench and temper method. At the present time, this product, in the P-105 grade, is manufactured by the normalize and temper method on a limited basis from steels shown in Table 2. In addition to the grades in Table 2, a 9 Ni and also 9 Cr steel have been used for producing tubing with minimum yield strength between 80,000 psi and 100,000 psi by the normalize and temper method. With suitable facilities, Grade N-80-P-110, and V-150 tubing, with or without an upset end, should be satisfactorily produced by the quench and temper method.

(Fig. 2 and 3 on page B-100.)

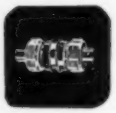
ROCKFORD

LONG LIFE
Heavy-Duty
POWER
TAKE-
OFF

40,000
HOUR
MAIN
BEARINGS


Small Spring Loaded

Heavy Duty Spring Loaded


Oil or Dry Multiple Disc

Heavy Duty Over Center

Power Take-Offs

Speed Reducers

The Timken main bearings in this new ROCKFORD Oil Field type POWER TAKE-OFF are calculated on the basis of 40,000 hours (5-10 Bearing Factor). These bearings are of ample size and capacity to give good service for the life of the engine with which this take-off is used. Your equipment will benefit from the long-life factor of this ROCKFORD extra Heavy-Duty POWER TAKE-OFF.

SEND FOR THIS HANDY BULLETIN
Gives dimensions, capacity tables and complete specifications. Suggests typical applications.

ROCKFORD Clutch Division BORG-WARNER
1303 Eighteenth Ave., Rockford, Ill., U.S.A.
Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

CLUTCHES

With Magcobar on your well ...

a bonus in engineering experience to cut your drilling costs

The Magcobar service engineer and the district engineer make certain that you are getting all the cost reducing advantages of a sound mud program. These two work as a team to see that you get the right products backed up by sound mud engineering.

The district engineer can speak with authority when working with you to plan a mud program. And this authority is grounded on long familiarity with the district and the knowledge of past well problems. His experience shows up in the most economical drilling program for your well.

You can expect from him the latest word on the newest developments from Magcobar. He is constantly studying the application of Magcobar products and of new techniques to district drilling problems. This information is yours for the asking.

The Magcobar district engineer is always on the go. One eye is kept on all the wells in his district; the other, on new techniques and new products being developed by Magcobar. Make certain that you get this extra bonus in engineering know-how on your next wells. Begin to plan with Magcobar now.

Magnet Cove Barium Corporation
Houston, Texas

Magcobar
Complete
DRILLING MUD SERVICE

58—101

A. F. KNAPPENBERGER
DRILLING CONTRACTOR - OIL OPERATOR
GRAHAM, TEXAS

April 25, 1957

Mr. Gordon P. Street, President
The Wheland Company
Chattanooga, Tennessee

Dear Mr. Street:

We started using your pumps back in 1937 and have continued to do so to the present time. We now have one HP-8000 and one HP-14000 in operation, which we believe is the most economical pump on the market to operate today.

The above two pumps have been in operation for several years, with practically no cost to us at all.

We operate the two rigs in North Texas area and drill contracts, interest deals, and our own account from 2000 to 7500 feet.

Yours very truly,

K&H DRILLING COMPANY

By: A. F. Knappenberger
Partner

20-Year User

of

WHELAND SLUSH PUMPS

cites their

low-cost operation!

Currently in use by K&H are Wheland HP-8000 and HP-14000 Pumps:

". . . in operation for several years with practically no cost to us at all."

—A. F. Knappenberger, Partner

On location in North Texas, the Wheland HP-8000 pump which has performed so well for K&H Drilling Co.

At the side, left to right, are Mr. Alton Henley, Co-owner; Mr. A. B. Drake, Wheland representative; Mr. A. F. Knappenberger, Co-owner.

WHELAND

HP-8000 DUPLEX SLUSH PUMP
7-¼" x 12", 220 HP Nominal Input at 70 RPM

•

HP-14000 DUPLEX SLUSH PUMP
7-½" x 14", 350 HP Nominal Input at 60 RPM

•

Wheland builds a Complete Line of Efficient Slush Pumps.

Write for Detailed Bulletins.

WHELAND

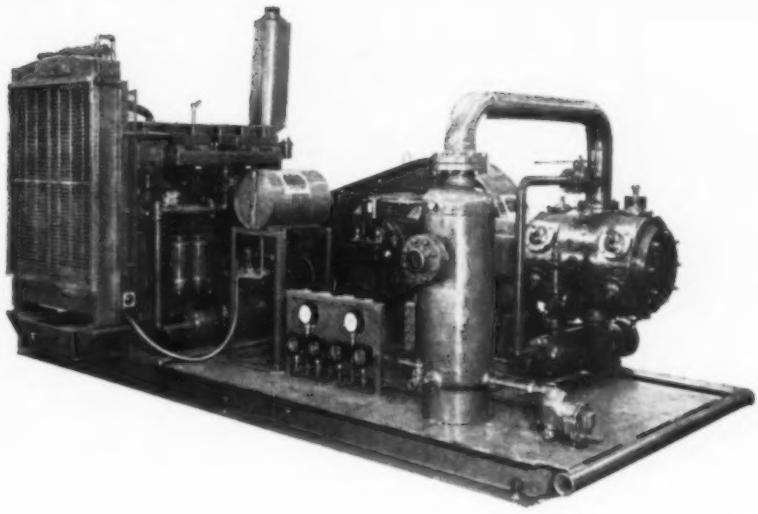
ROTARY DRILLING MACHINERY

THE WHELAND COMPANY
CHATTANOOGA, TENNESSEE, U.S.A.
DRAW WORKS • SLUSH PUMPS • ROTARIES
CROWN BLOCKS • TRAVELING BLOCKS • SWIVELS

DOMESTIC DISTRIBUTORS: INDUSTRIAL SUPPLY COMPANY, INC.—Main Office: Wichita Falls, Texas • HOUSTON OIL FIELD MATERIAL COMPANY, INC.—Main Office: Houston, Texas • JONES AND LAUGHLIN STEEL CORPORATION, SUPPLY DIVISION—Main Office: Drawer 2481, Tulsa 2, Oklahoma.

EXPORT DISTRIBUTORS: LUCEY EXPORT CORPORATION—233 Broadway, New York 7, New York—Broad Street House, London, E. C. 2, England.

Ready for the Field: 150 HP, Single Stage, Low Pressure, ESH Wilson Supply-Ingersoll-Rand Compressor. (Sales Gas.)



WILSON SUPPLY—INGERSOLL-RAND COMPRESSORS

ARE

Engineered to Cost You Less

The type "ESH" Compressors are completely new. In them have been incorporated features that assure continuous, low cost operation. They are adequately valved with type "A" CHANNEL Valves with "double life" seats in low and medium pressure cylinders and the dependable type "K" valves in the high pressure units.

Every installation is engineered to meet specific, individual well conditions — and is completely fabricated to give trouble-free performance.

These features mean profit and satisfaction to you:

- Completely sealed frame.
- Sealed distance-piece.
- Full-floating aluminum bearings.
- Force-feed lubrication with full flow filter.
- Window-type oil level indicator.
- Low-oil-pressure protection.
- Aluminum crosshead shoes.
- Bored crosshead guide.
- Full-floating metallic packing.

WRITE FOR COMPLETE INFORMATION.

"WHAT YOU WANT — WHEN YOU WANT IT"

MAIN OFFICE and WAREHOUSE—1301 CONTI ST.

BRANCH STORES

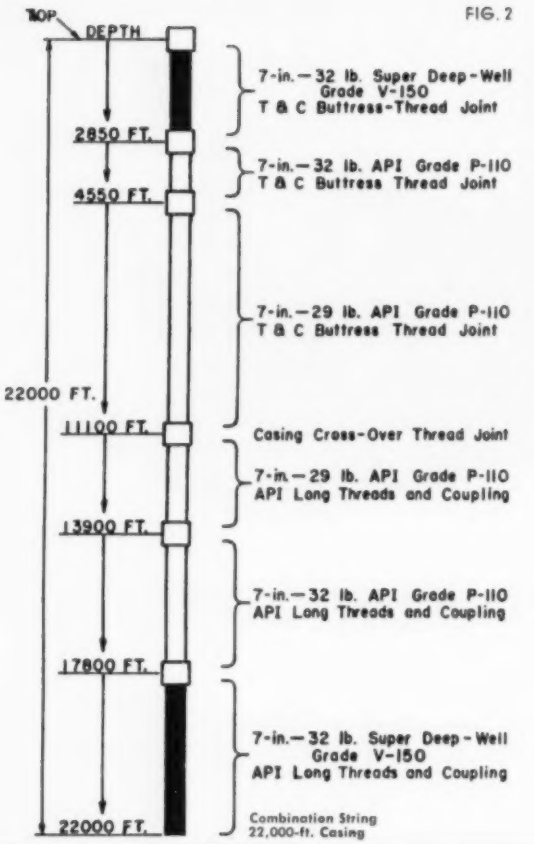
TEXAS: Alice, Corpus Christi, Victoria, McAllen, Bay City, Columbus, Barbers Hill, Liberty, Beaumont, Kilgore, Odessa, San Antonio. LOUISIANA: Lake Charles, New Iberia, Houma, Harvey, Shreveport. NEW MEXICO: Hobbs.

SALES OFFICES

DALLAS SHREVEPORT SAN ANTONIO
TULSA NEW ORLEANS LAKE CHARLES
CORPUS CHRISTI MIDLAND

WILSON SUPPLY CO

HOUSTON, TEXAS


TOP
DEPTH
2850 FT.
4550 FT.
22000 FT.
11100 FT.
13900 FT.
17800 FT.
22000 FT.
7-in.—32 lb. Super Deep-Well Grade V-150 T & C Buttress-Thread Joint
7-in.—32 lb. API Grade P-110 T & C Buttress Thread Joint
7-in.—29 lb. API Grade P-110 T & C Buttress Thread Joint
Casing Cross-Over Thread Joint
7-in.—29 lb. API Grade P-110 API Long Threads and Coupling
7-in.—32 lb. API Grade P-110 API Long Threads and Coupling
7-in.—32 lb. Super Deep-Well Grade V-150 API Long Threads and Coupling
Combination String 22,000-ft. Casing
FIG. 2

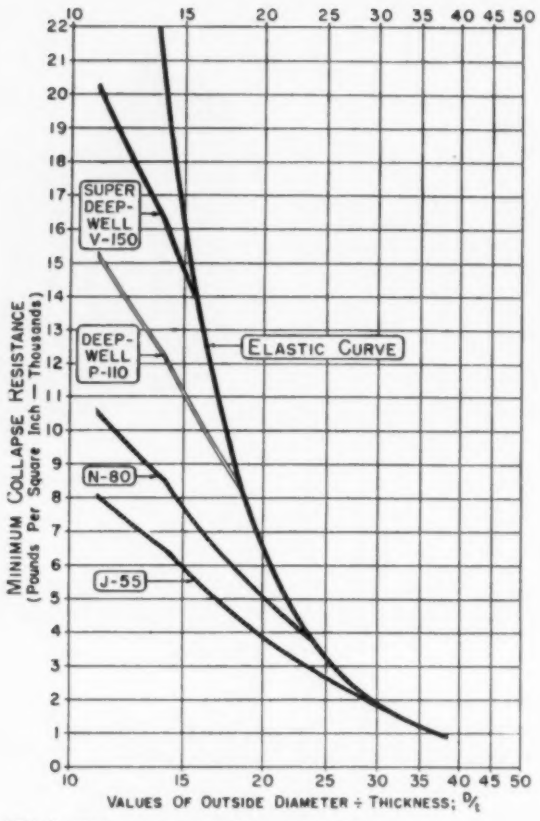


FIG. 3 Minimum Collapse Resistance Of Casing

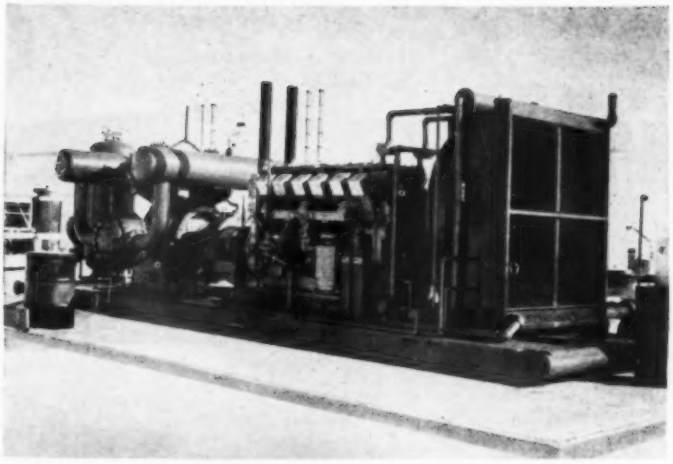
NEW TYPE F OTIS REMOVABLE GAS LIFT VALVE

Only two moving parts... no metal moving parts... completely balanced ... completely surface-controlled... same valves can be used for either continuous or intermittent flow—

OTIS / Branches Throughout the Oil Country

OTIS PRESSURE CONTROL SERVICE - EQUIPMENT

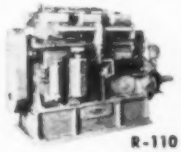
TULSA NEW ORLEANS LAKE CHARLES
CORPUS CHRISTI MIDLAND



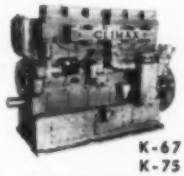
FOR POWERING COMPRESSORS

HORSEPOWER RATINGS(1)											
Model	No. of Cyls.	Bore and Stroke	Cu. In. Displ.	WITH Radiator and Fan				WITHOUT Radiator and Fan			
			(2)	800	900	1000	1030	800	900	1000	1030
R-110	4	6⅛x7	824	58	64	69	71	61	68	75	77
R-165	6	6⅛x7	1238	85	95	103	105	90	101	110	113
K-67	6	7x7	1616	118	131	143	146	122	137	150	154
K-75	6	7½x7	1855	135	151	166	169	139	156	172	176
V-80	8	7x7	2155	153	171	187	190	157	177	195	200
V-85	8	7½x7	2474	181	200	216	221	186	206	224	230
V-122	12	7x7	3232	238	265	288	293	244	272	298	304
V-125	12	7½x7	3711	276	312	340	346	284	319	350	357

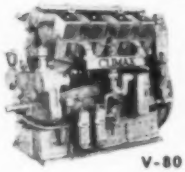
(1) These are continuous duty (API) ratings.
(2) R.P.M.



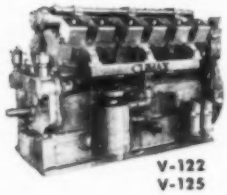
R-110
R-165



K-67
K-75



V-80
V-85



V-122
V-125

BIGGEST VALUE IN THE ENGINE INDUSTRY

Here's Why

1. All models have a 7" stroke.
2. All main and connecting rod bearings are the precision type.
3. All intake and exhaust valves are the free-to-rotate type.
4. All cylinder blocks are provided with renewable sleeves (except R series).
5. All cylinder blocks are cast separate from the crankcase.
6. All pistons are aluminum, cam ground and have five (5) rings.
7. All crankshafts have a main bearing on each side of each crankthrow (except R series).
8. All connecting rods are rifle-drilled for pressure lubrication of piston pins (except R series).
9. All cylinder heads have Climax high turbulence type combustion chambers which produce maximum fuel economy.
10. All crankcases and engine bases have large hand holes on each side for easy access to main and connecting rod bearings and the oil pump.
11. All models have the Climax consistent design that makes possible maximum interchangeability of wearing parts.

These important features mean less down time, easier and faster field servicing and lower maintenance costs.

Ask your nearby Climax Distributor for full details today!

CLIMAX ENGINE MANUFACTURING COMPANY
208 South LaSalle Street • Chicago 4, Illinois
DISTRICT OFFICE—1212 TOWER PETROLEUM BLDG., DALLAS 1, TEXAS
FACTORY—CLINTON, IOWA

DISTRIBUTORS • *Sales and Service*

CARTER ENGINE AND EQUIPMENT CO.
Abilene, Tex.

CULLANDER MACHINERY CO.
Belzoni, Miss. and West Memphis, Ark.

DRILLERS MACHINE SHOP
Oklahoma City, Okla. and Borger, Tex.

GENERAL DIESEL AND EQUIPMENT COMPANY
Williston and Fargo, N. D.

HOUSTON ENGINE AND PUMP CO.
Houston and Corpus Christi, Tex.

INDUSTRIAL POWER AND SUPPLY CO.
Longview, Tex.

MIKE CARTER ENGINE WORKS
Wichita Falls, Tex.

MIKE CARTER ENGINE SERVICE
Odessa, Tex.

TOBIN MACHINERY CO.
Lafayette, La.

UNITED POWER, INC.
Shreveport, La.

VERN WALTON CO.
Coolidge and Casa Grande, Ariz.

SHRIMPTON MFG. AND SUPPLY CO.
Los Angeles and Bakersfield, Calif.

In Canada: THE CANADIAN FAIRBANKS-MORSE CO., LTD., Montreal, Quebec, and 16 Branches

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

GREATEST ADVANCEMENT IN SWAB HISTORY!

The Oil States Swab is the most advanced swab on the market having been developed and perfected after years of research, painstaking work and engineering skill. It's acceptance has been overwhelming.

HERE ARE THE FEATURES YOU WANTED

★ Fewer cups to handle ANY job

★ Responds to lightest loads

★ Swab can be EASILY UNLOADED at any time

★ Valve action from base of cup

★ Perfect for swabbing following frac jobs

★ Only 6 parts Required to Assemble a 2-Cup Swab

SOLD THROUGH SUPPLY STORES EVERYWHERE

(CUTAWAY)

Oil States

OIL STATES RUBBER CO.
ARLINGTON, TEXAS

Houston API Names 1958 Officers

Houston chapter of American Petroleum Institute has installed its 1958 officers. Chairman is Thomas "Tucker" Pennington, Humble Oil & Refining Company. R. M. Darling of Pan American Petroleum Company and B. O. Ellington of Baker Oil Tools, Inc., are first and second vice chairman, respectively. Secretary-treasurer will be E. W. Fore, Jr., of Parkersburg Rig & Reel Company. All of the officers reside in Houston.

Elected as advisors were Roy A. Bobo of Phillips Petroleum Company, H. M. Krause of Humble Oil & Refining Company, W. H. Rosser of Continental Oil Company, Phillip Davis of Magnolia Petroleum Company, W. M. Paggi of Sun Oil Company, J. B. Fleming of Welex Jet Services, Fred Chisholm of Magnet Cove Barium Corporation, Richard Dobson of Shell Oil Company, Joe Battle of The Texas Company, George Justice of HOMCO, Herb Treichler of H.E.T. Drilling Company, Whitt Daniels of John Mecom's interests, and J. B. Butler of Oil Production Maintenance Company.

J. L. Wilson of Atlantic Refining Company is program chairman and Rex Galloup of Edwards Valve Company is membership chairman. E. J. Slavinsky of Gulf Oil Corporation is in charge of arrangements, and A. W. Short of Reed Roller Bit Company is in charge of entertainment.

Houston API Chairman Thomas Pennington and E. W. Fore, secretary-treasurer.

Second vice chairman is B. O. Ellington; R. M. Darling is first vice chairman.

Begin My Subscription NOW!

The Petroleum Engineer Drilling and Producing*	☐ $3.00 1 Yr. ☐ $6.00 3 Yrs.
The Refining Engineer*	☐ $3.00 1 Yr. ☐ $6.00 3 Yrs.
The Pipeline Engineer*	☐ $3.00 1 Yr. ☐ $6.00 3 Yrs.
The Petroleum Engineer For Management**	☐ $8.00 1 Yr. ☐ $18.00 3 Yrs.

*Specialized Edition of The Petroleum Engineer **Integrated Edition

☐ Payment Enclosed ☐ Bill Me

NAME_____

POSITION_____

ADDRESS_____ ☐ Home ☐ Company

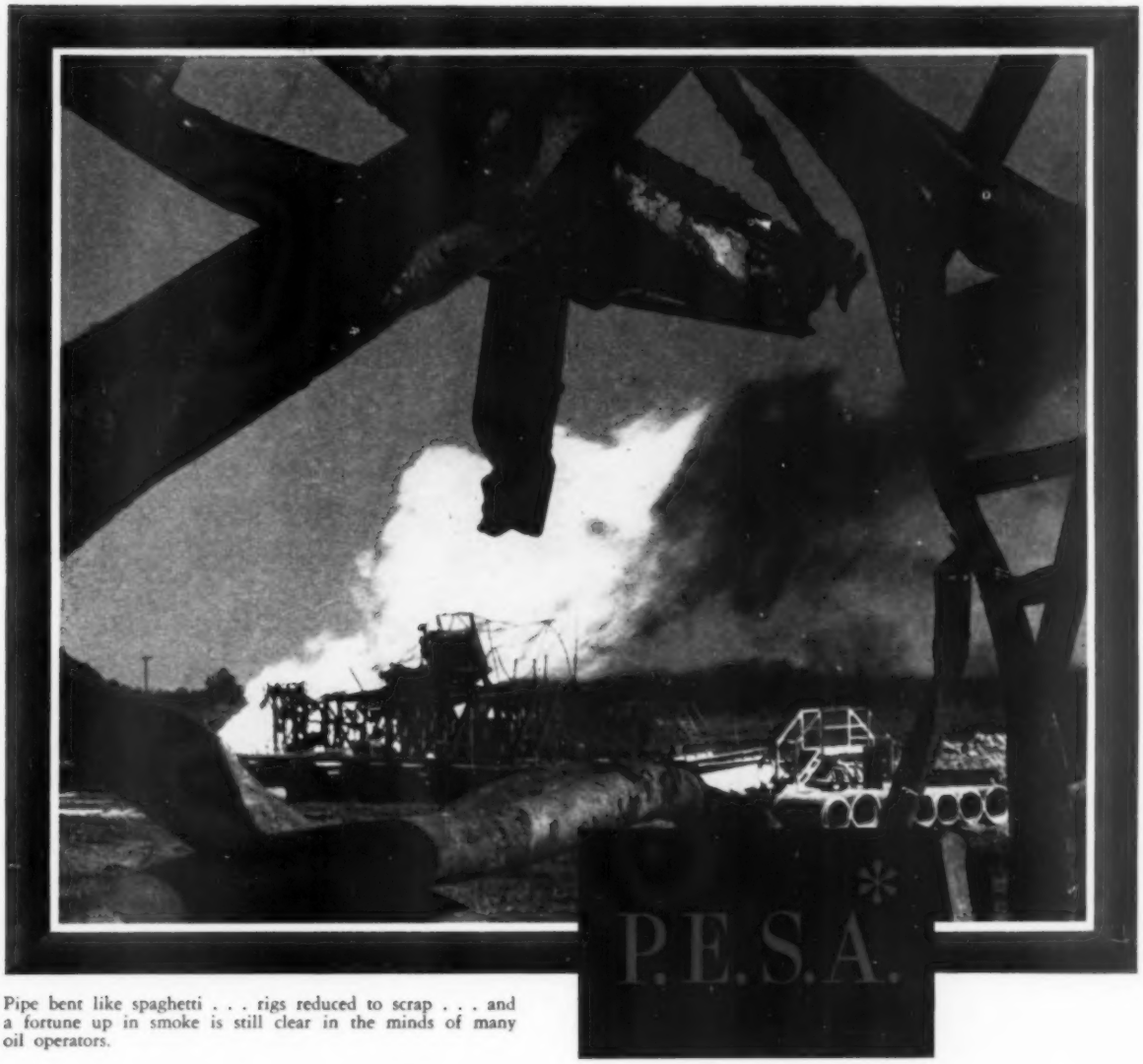
COMPANY_____

CITY_____ ZONE____ STATE_____

Please check division of industry engaged in

☐ Drilling ☐ Refining ☐ Supply
☐ Producing ☐ Petrochemical ☐ Manufacturing
☐ Pipe Line ☐ Natural Gasoline ☐ Contractor

Why Blowouts Are Getting Few And Far Between



Pipe bent like spaghetti . . . rigs reduced to scrap . . . and a fortune up in smoke is still clear in the minds of many oil operators.

In the middle 1930's, spectacular blowouts and costly fires were almost commonplace. Practically every new field, where deeper exploration was in progress, was pock-marked with a crater or two, grim reminders for the rigs that followed of the hazards that lay ahead for them.

The recognized discovery of "drilling mud" came with Spindletop where cows were driven through the earthen tanks to mix mud. Surface controls, such as blowout preventers, gained prominence after the famous "Wild Mary" Sudik in Oklahoma City.

Steady improvements in controlled drilling fluids and surface control equipment signalled the start of a new era in deeper drilling and completion practices. Throughout all the development stages of better well control, oil operators and PESA Members have worked as a team.

Still, there is much to be done.

And much of it will be accomplished in the future, as in the past, through the research facilities, time, money and personnel of members of the Petroleum Equipment Suppliers' Association.

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION

*
PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION

57—103

PROUD TO BE PART OF A PIONEERING INDUSTRY

NOW from TRETOLITE

TRETOLITE COMPANY

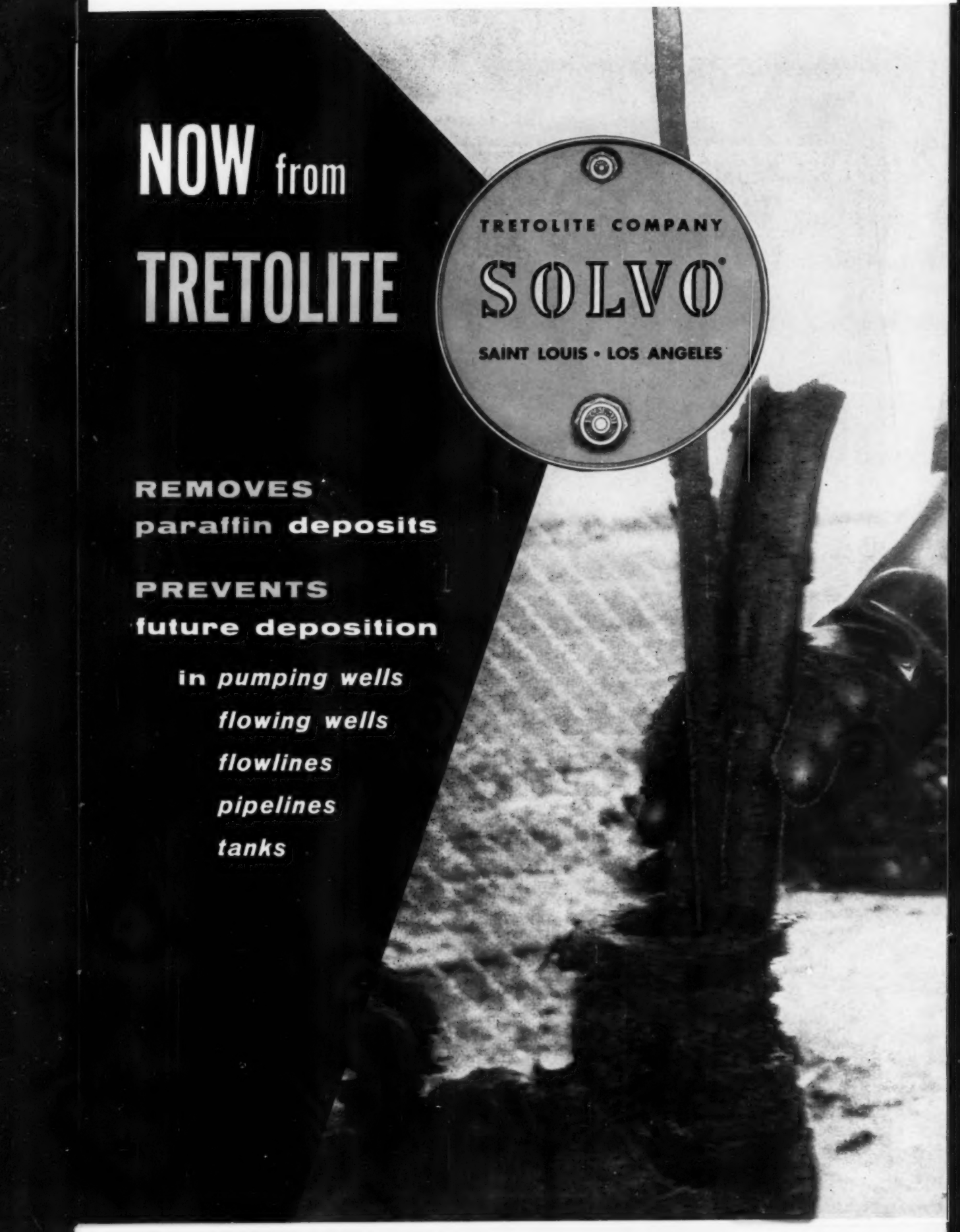
SOLVO®

SAINT LOUIS • LOS ANGELES

REMOVES
paraffin deposits

PREVENTS
future deposition

in *pumping wells*
flowing wells
flowlines
pipelines
tanks



SOLVO®

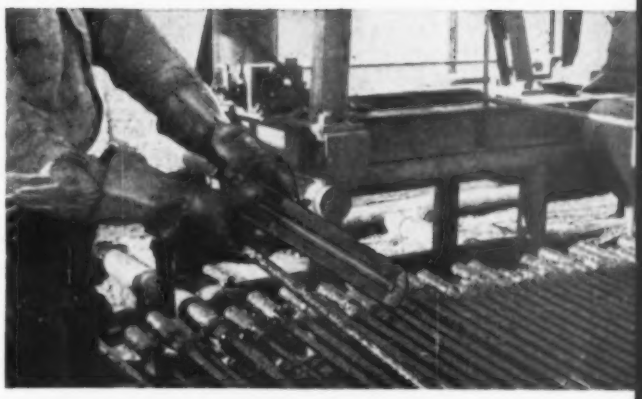
NEW PARAFFIN REMOVER CONTAINS NO ORGANIC CHLORIDES!

why chlorine-free SOLVO is important to producer and refiner

The organic chlorides found in most chemical paraffin removers remain in the crude—following it to the refinery where they adversely affect the performance of the catalysts used in catalytic reforming. Refinery tests show that as little as 5 gallons of paraffin "solvent" of this kind can contaminate as much as 30,000 barrels of crude, and affect the over-all refinery operation. *SOLVO contains no components which will adversely affect refinery operations.*

how SOLVO is used

SOLVO is available in a variety of formulas; most of which are dispersible in both oil and water, and may be used in either type of diluent. Such dispersions may be relatively concentrated or as dilute as 1%. SOLVO has a high flash point and low vapor pressure, making it safe to use.



Paraffin accumulations such as these plug wells and flow lines, and rob operations of top dollar-efficiency. *SOLVO* has been designed to *prevent* such deposition and eliminate the necessity for frequent pulling and steaming jobs!

effective wherever crude petroleum is produced, transported or stored

Whether your paraffin problem is in a pumping well, tank or flowline, SOLVO works quickly, efficiently, inexpensively. Your local Tretolite Service Engineer is ready to show you how to get the most successful results from this and any other Tretolite product.

TRETOLITE COMPANY

DIVISIONS OF PETROLITE CORPORATION

369 Marshall Avenue, Saint Louis 19, Missouri
5515 Telegraph Road, Los Angeles 22, California

Chemicals and Services for the Petroleum Industry

DEMULSIFICATION • DESALTING • CORROSION INHIBITING • PARAFFIN REMOVAL • SCALE PREVENTION
WATER DE-OILING • INJECTIVITY STIMULATION

TPR-58-1

WANT MORE INFORMATION?

Write to nearest headquarters for Illustrated Brochure.

TRETOLITE COMPANY
Divisions of Petrolite Corporation
369 Marshall Avenue, St. Louis 19, Missouri
5515 Telegraph Road, Los Angeles 22, California

Gentlemen: I'm interested in SOLVO, your new chlorine-free paraffin remover. Send me new illustrated brochure.

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

Canada Views More Exploration, Less Production in 1957

Short market for Canadian crude forces industry to trim development drilling, production forecasts

A temporary leveling-off period for the Canadian oil picture is forecast by the Canadian Petroleum Association, based on statistics and surveys of its industry in 1957.

Temporary recessions occurred during the latter half of last year in certain phases of the industry. Volume of oil production dropped, drilling activity dropped and consumption of petroleum products dropped. It is anticipated, however, that the eventual future of Canada's petroleum industry is promising, in light of many developments during 1957.

Exploration and Development

Significant oil discoveries were made in Alberta at Innisfail in the central part of the province, and at Swan Hills, Virginia Hills, Edith Lake and Kaybob, all northwest of Edmonton. Discoveries in Saskatchewan were generally in the southeast portion of the province, with the Hummingbird discovery standing out because it is probably the first Ordovician discovery to be made in Canada.

An important British Columbia oil discovery was made at Blueberry in the northeast section of the province. Also, the Boundary Lake field in the same sector was extended considerably by a number of step-out wells.

Oil activity in the Maritimes was limited primarily to geophysical surveys. This exploration consisted mostly of seismic surveys in Prince Edward Island and some gravity surveys in Nova Scotia. Further, some airborne magnetometer surveys were carried out over the Atlantic provinces. No major discoveries were made.

Two development wells were drilled in New Brunswick's Stoney Creek field, where a new extraction process is being used to recover oil. As a result, New Brunswick's production rose markedly, although it is still insignificant as far as total Canadian production is concerned.

Manitoba exploration in 1957 has been fairly well limited to the southwest section of the province. There has been little success in finding new fields, and production from the existing fields has about reached its maximum.

Drilling Industry

A fall-off of 10 percent occurred in total footage of wells drilled in the first eleven months of 1957. Development drilling in Western Canada fell off 16 percent from 1956, while exploratory drilling increased eight percent, in part offsetting the drop in the development drilling.

Secondary Recovery

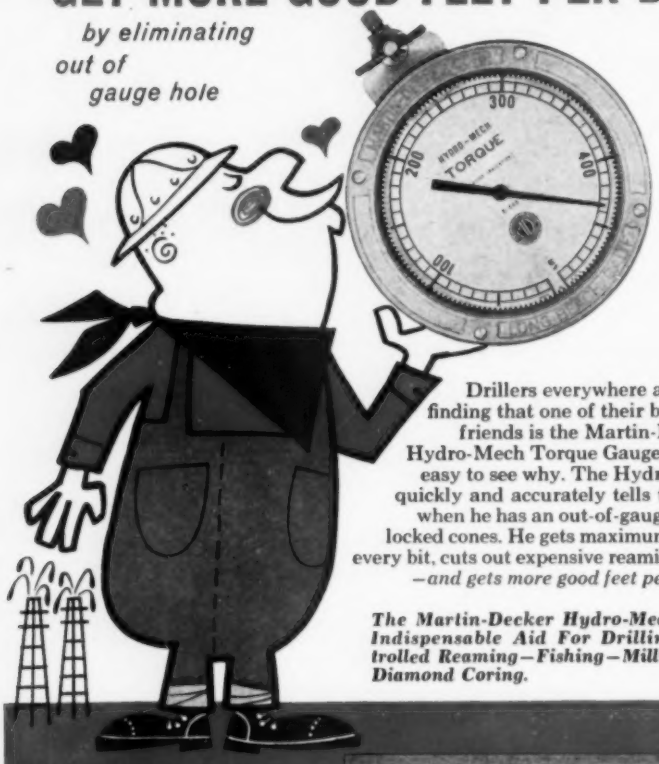
To increase Canada's oil reserves, secondary recovery projects have been undertaken in the Pembina and Turner Valley fields.

(Continued on page B-111)

Martin-Decker helps you

GET MORE GOOD FEET PER BIT

by eliminating out of gauge hole



Drillers everywhere are fast finding that one of their best friends is the Martin-Decker Hydro-Mech Torque Gauge. It's easy to see why. The Hydro-Mech quickly and accurately tells the driller when he has an out-of-gauge hole or locked cones. He gets maximum use from every bit, cuts out expensive reaming time *—and gets more good feet per bit.*

The Martin-Decker Hydro-Mech Is An Indispensable Aid For Drilling—Controlled Reaming—Fishing—Milling—and Diamond Coring.

- A rugged instrument of remarkable sensitivity
- Easy to read and understand
- Operates with any chain driven rotary
- Stabilizes chain and gives it longer life
- Minimizes danger of twist-offs
- Increases footage when drilling with small bits

Write For Descriptive Literature!

MARTIN-DECKER CORP.

HOME OF THE WEIGHT INDICATOR —— LONG BEACH, CALIFORNIA

TPR-58-1

ADDRESS

CITY ZONE STATE

This wellhead test stand area in our Corpus Christi store is one of six similar field facilities in the United States and Canada.

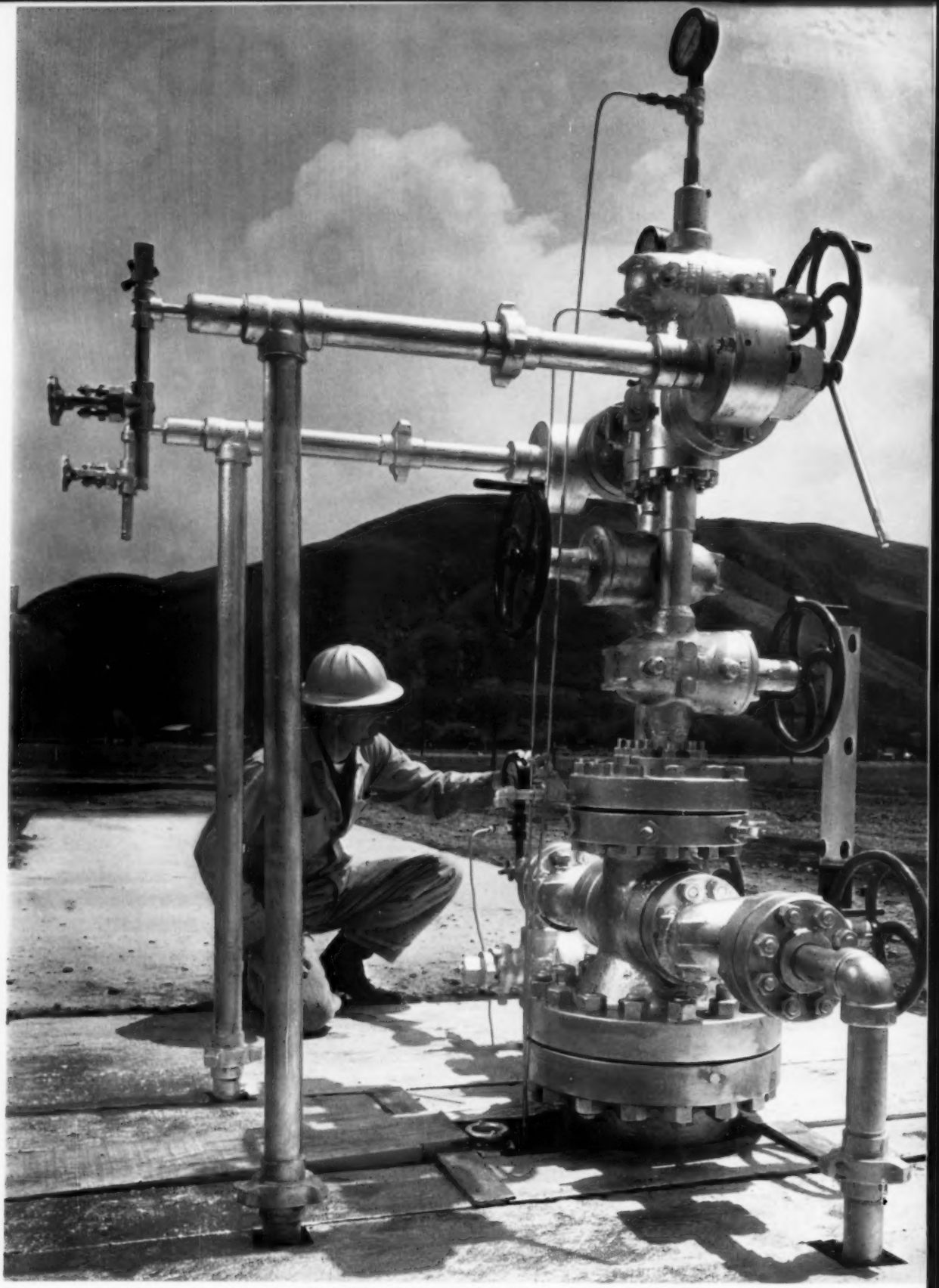
Wellhead test stand is another National field service

When you need repair and reconditioning work on wellhead equipment you usually need it fast. Above all, you must be sure of a unit's safety. For these reasons, National Supply maintains six conveniently-located wellhead test stands in the United States and Canada.

These special field facilities for the hydrostatic testing of wellhead assemblies save more than time. Because they are in, or close to, major production areas, operators save on shipping and handling costs. Add to these benefits the complete line of wellhead parts and specialty items immediately available in National Supply Store stocks . . . and you have the reasons why this wellhead service is so popular.

The next time you need a "like new" repair or reconditioning job on a wellhead assembly, contact the National representative or store personnel in your area. You'll get fast service and thoroughly tested, quality equipment. In fact, these are the same two results you get on whatever you buy from National Supply.

National dual-completion equipment on the next page



This National Supply dual completion wellhead assembly is located near Ventura, California. It utilizes the time-proven Laurent* seal, provides completion cycle "Preventer Control" and sealed-in-steel construction for the life of the well.

You get safe, profitable completions with National dual string wellhead equipment!

All the basic benefits of field-proved National Wellhead Equipment are contained in National's dual string assemblies. Simplicity of design makes them easy to assemble and maintain. Parts are self-locating and self-activating. Interchangeable units provide a flexibility that enables you to "do more with fewer pieces." And, every assembly is intensively pre-tested to insure complete safety.

National offers five types of dual string wellhead equipment designed for safe, profitable completions in a full range of working pressures:

Type DST—Used in any National Type E, W, and B, 6" nominal size tubing heads over 5½" or larger casing. Generally installed on dual zone pumping installations requiring a macaroni or vent string.

Type DS-1—These bonnets provide maximum flexibility and greatest economy for shallow or medium depth wells. Ordinarily used on medium pressure wells, they are easily converted to pumping installations.

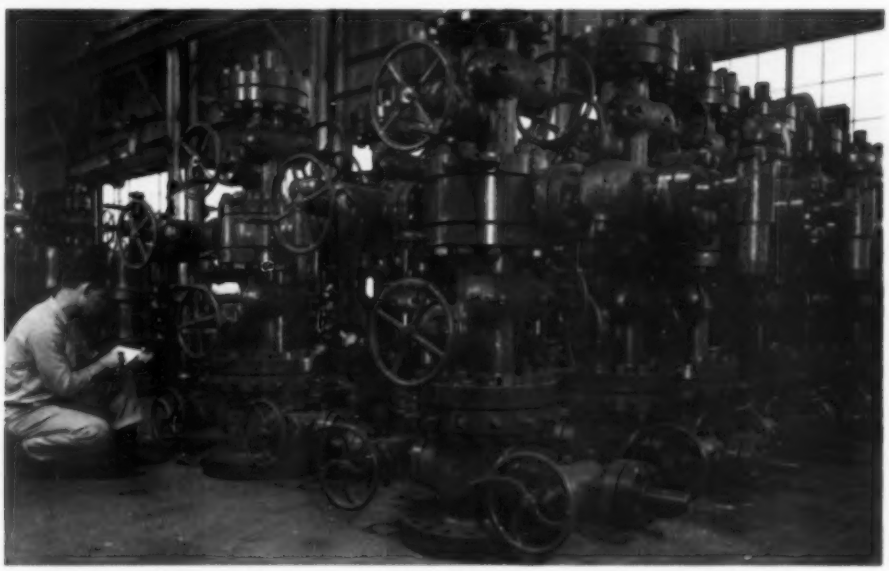
Type DF-1—Similar to DS-1, but incorporating the efficient Laurent* seal. Used for medium or deep wells where independent flanged valves are desirable, and controlled displacement is required.

Type DP-1—Permits "controlled completion." It is supported in a hanger body for suspension of the tubing strings, and allows either string to be pulled, subsequently, without disturbing the other.

Type DP-3—Has an advanced automatic hanger design which eliminates the need for over-size preventers in "controlled completions."

Get the complete story on the benefits of National dual string wellhead equipment from the National representative in your area. It could save you much time and money.

*Patent No. 2,687,229



Serial numbers are checked on these dual completion assemblies ready for shipment from National Supply's Houston Plant. National assemblies for every wellhead condition —as well as advisory service on applications—are available through National Supply Stores.

More National equipment for profitable production on the next page

National Triplex Pumps are reliable on a host of oilfield pumping jobs including water-flooding, salt water disposals, and as power-oil sources for subsurface hydraulic pumps.

...and you get low-cost pumping with National Triplex Pumps!

A minimum of pumping downtime means low-cost pumping, and that's what you get with National Triplex units. They have heavy-duty housings and frames, long-life bearings, stainless steel valves, and National's time-proven lubrication systems.

Plungers, fluid ends and cartridge-type stuffing boxes are readily interchangeable to meet varying pressure and volume needs, and are available for either corrosive or non-corrosive service. In every respect, these triplex pumps show the quality construction for which all National Supply equipment is famous.

Ask the National representative in your area for more information on National Triplex Pumps—and any of the other dependable production equipment shown on this page.

Get reliable service from precision-made National Sucker Rods. They have top resistance to fatigue, shock, corrosion and impulse loads. National Sucker Rods are available in a range of grades to meet every well condition.

National Pumping Units are manufactured in 22 standard combinations, plus various long stroke and portable variations. In the range of API rated beam loads from 3,200 to 32,400 lbs., there's a unit to economically meet your needs.

National Plunger Lift can be the best production method for certain types of wells. It uses formation gas or injected gas for operation, has low initial and service costs. Equipment is also available for gas well operation to remove liquids and maintain a uniform and increased flow rate of gas.

THE **NATIONAL SUPPLY** COMPANY

MAIN OFFICE: Two Gateway Center, Pittsburgh 22, Pa.
DIVISION OFFICES: Dallas; Denver; Houston; Toledo; Tulsa; Torrance
CANADA: The National Supply Company, Ltd., 200 F. W. Clark Building, 709 Eighth Avenue, West, Calgary, Alberta
EXPORT: 600 Fifth Avenue, New York 20, N.Y., U.S.A.; City Wall House, Chiswell Street, London E. C. 1

NATIONAL BLUE OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE AND ELECTRICAL CONDUIT

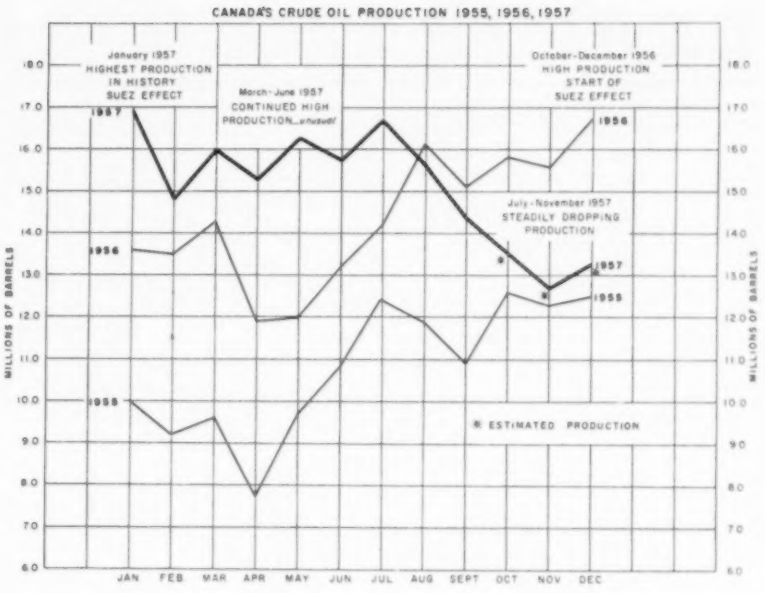
(Continued from page B-106)

Initiated by Canadian Seaboard Oil Company, several companies are using water injection plans in Pembina, a low pressure field. It is expected that three times as much oil will be recovered from the wells on which it is being used as there would be if no secondary recovery method were used. A gas injection plan is expected to yield just as spectacular results in another part of the field.

In the Turner Valley field, Home Oil Company Limited is planning a water injection program to recover oil which could not be recovered by other methods.

Canadian Oil Production

While Canadian crude reserves have increased during the year, the production of this oil has slowed down somewhat during the latter half of 1957. It reached an all-time high during and after the Suez crisis, but fell off rapidly later in the year. The graph gives an idea of what happened.


CANADA'S CRUDE OIL PRODUCTION 1955, 1956, 1957
January 1957 HIGHEST PRODUCTION IN HISTORY SUEZ EFFECT
March-June 1957 CONTINUED HIGH PRODUCTION...unusual
October-December 1956 HIGH PRODUCTION START OF SUEZ EFFECT
July-November 1957 STEADILY DROPPING PRODUCTION
1957
1956
1955
* ESTIMATED PRODUCTION
MILLIONS OF BARRELS
JAN FEB MAR APR MAY JUN JUL AUG SEPT OCT NOV DEC

Only in the Province of Saskatchewan did oil production rise. This increased about 75 percent in 1957. This was due to increased oil marketing in Eastern Canada and because the Province's St. Paul, Minnesota, market for medium gravity crude was relatively unimpaired.

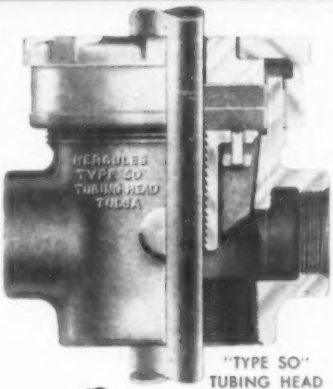
Hardest hit by the drop in crude production toward the end of the year was Alberta. For the first time in ten years Alberta production was down from the previous year. It was that province's oil that was shipped to California during the Suez crisis. When the crisis ended and tanker rates dropped, the California market was lost.

Slowdowns also occurred in the consumption of petroleum products, although the drop has not affected Canada's recently won position as the world's second largest consumer of petroleum products. However, it was the first time since 1954 that increase in the rate of consumption has fallen off.

there's a Hercules tubing head

TO FIT YOUR REQUIREMENTS...

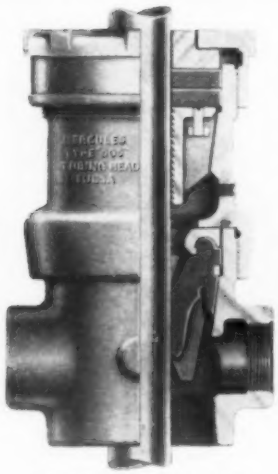
HERCULES "Type SO" Tubing Head is particularly suited for pumping due to compactness (only 12½" high). Stripper rubber can be used in body for running or wiping tubing. Also ideal for intermittently flowing wells.



"TYPE SO" TUBING HEAD

HERCULES "Type SO" and "SOS" Tubing Heads are the favorite of successful operators because of their simplicity, ruggedness and ease of operation. Available in 4½" OD to 7" OD Casing Sizes to suspend 2", 2½" or 3" tubing. Constructed from pressure cast steel and tested to 4,000 PSI. Slips are hinged for ease of installation and positive alignment.

HERCULES "Type SOS" Stripper Tubing Head is unsurpassed for use in well servicing operations as well as on flowing wells. It consists of a HERCULES "Type SO" Tubing Head with a bowl and Neoprene Tubing Stripper.



"TYPE SOS" TUBING HEAD

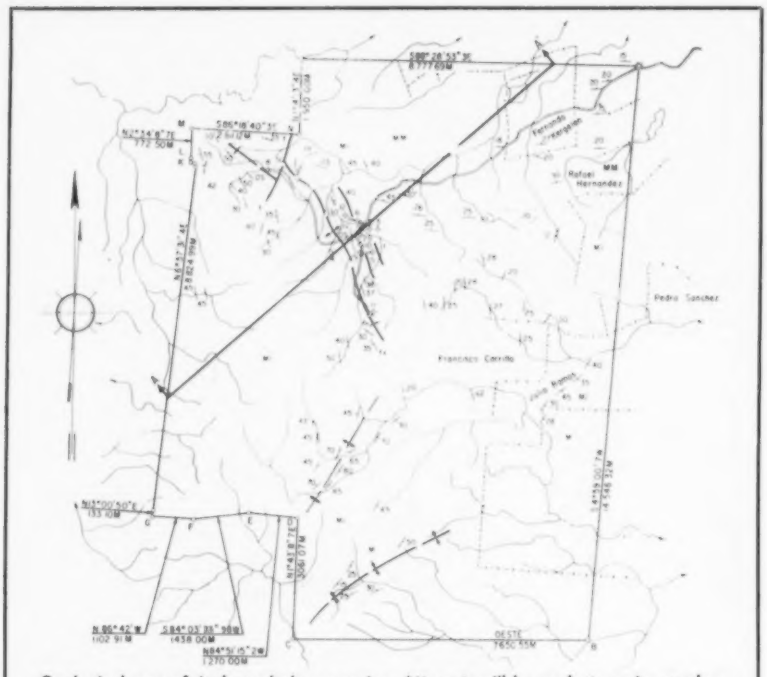
HERCULES TOOL Company

"MANUFACTURERS OF OIL FIELD EQUIPMENT SINCE 1924"

GENERAL OFFICES AND PLANT TULSA, OKLAHOMA

Available through all supply stores: Export Representative: Oil Field Equipment Co., Inc., 30 Church Street, New York 7, N. Y.

EXPLORATION ACTIVITIES



Geological map of Ambassador's concession. Attempts will be made to revive production from some of the wells indicated in the northwest quarter of the area.

COLOMBIA

Ambassador Takes Floresanto Concession; Drilling Commences Immediately

A 40,000-acre concession, formerly held by Dr. Victor Oppenheim, (Oppenheim & Briscoe, Dallas, Texas), has been transferred to Ambassador Oil Corporation, Fort Worth, Texas, and drilling work is already said to be underway.

The Floresanto Concession, held by Oppenheim for several years, is located along the Sinu River 100 miles south of the Caribbean coastal city of Cartagena in the state of Cordova. Several other oil companies are operating in the vicinity.

Transfer agreement called for Ambassador to start immediately on exploration work and proceed to drill at least two wells a year. A former owner of the concession, Socony Mobil, had two shallow producing oil wells. Several others have been drilled.

It was indicated that the two producers would be tested. These produced 50 deg oil from a depth of about 1500 ft. An attempt would be made to develop deep production from formations between 8000 and 10,000 sq ft. Sun, Socony and International Petroleum operate in the Sinu Basin, the immediate area of the Floresanto Concession. It is reported that arrangements have already been made with International to purchase any crude produced by Ambassador.

WEST AFRICA

Drilling Starts in Senegal

Following geophysical surveys in South Senegal, a deep test well will be drilled by the Societe des Petroles du Senegal, which was formed in 1956 to carry out oil exploration in Casamance area of French West Africa. BP Exploration Company has a 30 percent holding in the company and BP's French associate, the Societe Francaise des Petroles BP, a 20 percent holding. The remaining 50 percent participation is in French hands. A drilling rig capable of reaching a depth of 12,000 ft recently arrived at Dakar. The rig and other equipment is being carried by small ships to the Casamance area, about 150 miles south of Dakar.

LIBYA

Texaco Works New Concession

Texaco Overseas Petroleum Company and California Asiatic Oil Company have been granted a 40,442 square kilometer concession in the Fezzan. Geological and geophysical work, expected to start early in 1958, will be done by American Overseas Petroleum Ltd. Amoseas is a member of the Caltex Group of companies.

NIGERIA

First Oil Reaches Market

First repayment of years of exploration and drilling is being made by the shipment of 12,000 bbl of crude from the Oloibiri field barged to Port Harcourt. Four wells in Eastern Nigeria's first field are now producing on a test basis. Output is expected to rise to 4000 bbl daily soon. New drilling and exploration plans have not yet been announced.

Clancy Pitts, drilling superintendent for An-Son Drilling Company is shown with the 300 hp trailer-mounted pump for the rig now in Colombia. An-Son is to drill on the Floresanto Concession. Completely rigged-up and tested prior to shipping from the Beaumont plant, the extensive engineering and planning of the mud system trimmed many hours of rig-up and moving time for the company in the field. The two mud tanks are designed to nest one inside the other in "piggy-back" fashion during moves, while at the same time serving as miscellaneous "carry-alls." Pump manifolding, together with a suction supercharger is mounted on a skid.

— Photo Courtesy Ideco

TEXAS

Pecos Well to Test Permian

Cities Service has released for drilling its wholly-owned University "BE" No. 1 on its 2880-acre Baldridge block approximately 15 miles northeast of Fort Stockton. The 5500-ft test is located 1980 ft from the north line and 1980 ft from the east line of Section 11, Block 26, University Land Survey, Pecos County, Texas. Objectives are several horizons in the Permian. Nearest production is from the Fromme pool approximately 7½ miles to the north.

New Bend Field in Montague

Marshall Pipe & Supply Company, Nocona, has opened a new Bend conglomerate field at its No. 1 Petty-A, two miles north of Bonita in Montague County. The discovery, which spots in the northeast quarter of the Rose Partridge Survey A-1487, is three miles northwest of similar production in the Bonita field.

The well flowed 189 bbl per day through a 14/64-in. choke on initial test. Casing was perforated opposite the Bend conglomerate at 5452-58 ft. Gas-oil ratio was 369 to 1.

Ellenburger Gas in New Area

Magnolia Petroleum is to complete its No. 1 Brown-Bassett, a Terrell County prospector, as a gas well from the Ellenburger lime. The deep well, in northwest of Section 219, Block Y of TCRR survey, is 39 miles northeast of Sanderson and marks first potential Ellenburger production in the area. Hole has been bottomed at 15,556 ft on a 16,000 ft contract, after having called the lime at 13,742 ft. The thick Ellenburger has been tested in several zones in the well, first at 14,895-945 ft. This test gaged 842,000 cu ft of gas a day on a 1-in. choke. After this test the well was plugged back to test at 14,120-186 ft and at 14,214-290 ft. These two were tested together.

CALIFORNIA

Signal Wildcats in Colusa, Ventura

Signal Oil and Gas Company is drilling an exploratory well on a 425-acre lease in the Arbuckle area of Colusa County. The well, designated Signal-Mathews No. 1, has as its objective the gas sands of the Cretaceous and is expected to be drilled to approximately 6700 ft. The nearest production is one-half mile away, where Western Gulf Oil Company's A. S. Wiggins No. 1 was recently completed for 7,500,000 cu ft per day of gas.

Signal also reported that it is drilling a deep exploratory well (Signal-Richfield-Monterey-Calumet No. 1) in the Shiells Canyon area in Ventura County. This operation, a farm out from Richfield, will give Signal drilling rights to 780 acres. The primary objective is the Middle Pico formation underlying the Oak Ridge thrust fault at an approximate depth of 10,000 ft, with the shallow Saugus being a secondary possibility. This play is similar to that of the Bridge area in Ventura County, where wells have been completed with initial production in excess of 500 bbl per day.

AUSTRIA

Light Crude — Heavy Gasoline Content

New field optimism has been tempered at a recent discovery west of the Matzen field. The exploratory well Pyrawarth 1 of the Oesterreichische Mineraloeverwaltung AG found the base of the Helvetian production at about 7900 ft. Flow tests yielded initially 28 tons per day of light crude with a high gasoline content (approximately 220 bbl per day). Rapid pressure decline has been noted with present pumping rate estimated at two tons a day.

NOBODY . . .
BUT NOBODY
BUT . . .
SPANG
makes a completely
weldless
alloy-steel
jar
drills up to 4 times more footage-with fewer fishing jobs
For Cable Tool data and catalog see your Spang dealer or write to:
HIGHER STANDARD
SPANG & COMPANY
Dept. O-7 Butler, Pennsylvania
For over 60 years Manufacturers of Spang Weldless Jars and a Complete Line of Cable System Drilling and Fishing Tools for Oil and Gas Wells, Prospect Drilling and Shot Blast Holes.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

FIELD ENGINEERED...

for proven dependability

MODEL 63

oilmaster

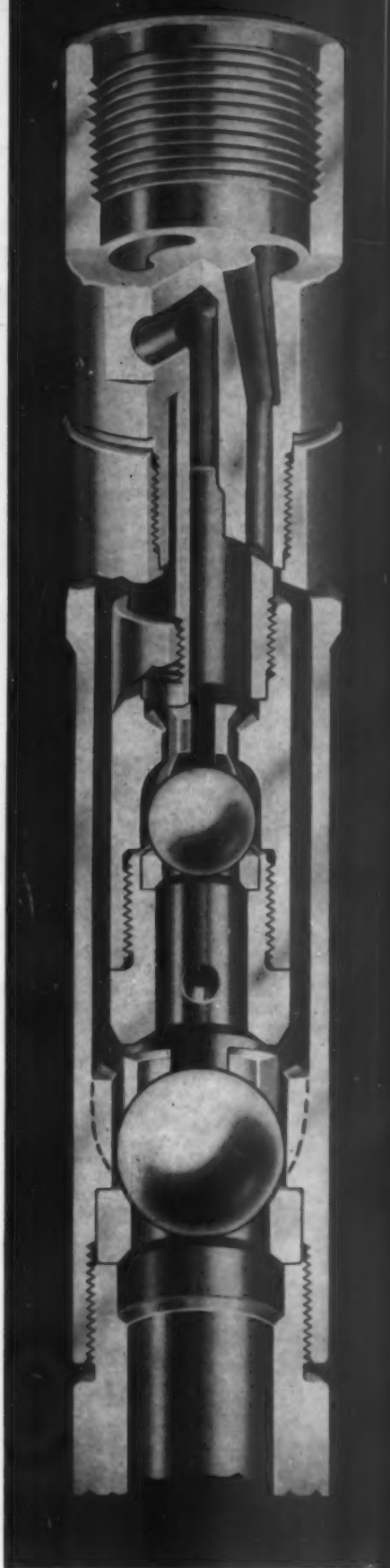
BOTTOM DISCHARGE VALVES

It has long been known that a bottom discharge valve would keep the area between the pump and tubing free of sand by discharging a portion of the produced fluid at the hold-down. As long as the upward velocity of the fluid exceeds the settling rate of the sand, the annulus remains clean.

Prior to the introduction of the Oilmaster Model 63, bottom discharge valves have not been as dependable as the other components of the pump. Still, they were in common use by operators who preferred to pull a pump prematurely if necessary, rather than risk pulling a tubing string wet.

Wet jobs are caused by a pump that is stuck so tightly in the tubing string that it cannot be unseated with the sucker rods. The sticking is most commonly caused by sand settling around the pump barrel above the hold-down. The worst hazard occurs in a stationary barrel bottom anchor pump, where the sand can fill in all the way to the top of the pump.

The Model 63 represents an entirely new approach to the pump valve design problem, and has overcome the weaknesses that previously existed. Numerous improvements have been made that can best be appreciated by a demonstration. Call your Oilmaster representative and ask him to bring out a Model 63 on his next call, or better, ask him to insure you against wet jobs by having him install them on all your stationary barrel bottom anchor or Multiple Tube Fluid Packed Pumps. Try them on long stroke pumps too, to eliminate the need of a top seal element.



FLUID PACKED PUMP CO.

Main Office and Plant, Los Nietos, California

Distributed by the National Supply Co., Pittsburgh, Pa.
Export: The National Supply Co., Export Division, 600 Fifth Avenue, New York
Co-Distributors: Union Supply Company, Beacon Supply Co., Industrial Supply Co.

oilmaster PUMPS FOREMOST IN THE INDUSTRY

For fishing, testing and core-drilling strings . . .

. . . plus Safety Joint protection!

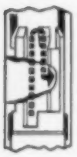
THE SHAFFER OIL-SEALED JAR SAFETY JOINT

The Shaffer Oil-Sealed Jar Safety Joint is the only tool that combines a choice of *jar-up* and *releasing* actions, both under complete control of the operator at all times. What's more, all operating parts are sealed in a chamber filled with clean oil, fully protected against mud, sand and corrosive fluids.

The sealed-in-oil protection not only safeguards against abrasion and corrosion, and minimizes pressure differentials on packing elements, but also insures constant operating characteristics at all depths. This makes the tool ideal for fishing, testing and similar strings where light connections and equipment are used!

Jar-Up Action

▶ **JARRING ACTION IS AUTOMATIC**—simply raise the drill string until tension equals the pre-set tripping load, whereupon a sharp *up* blow is struck. Lowering the tool automatically re-sets the tripping mechanism for another blow—and repeated blows can be struck as fast as the string can be raised and lowered.



Releasing Action

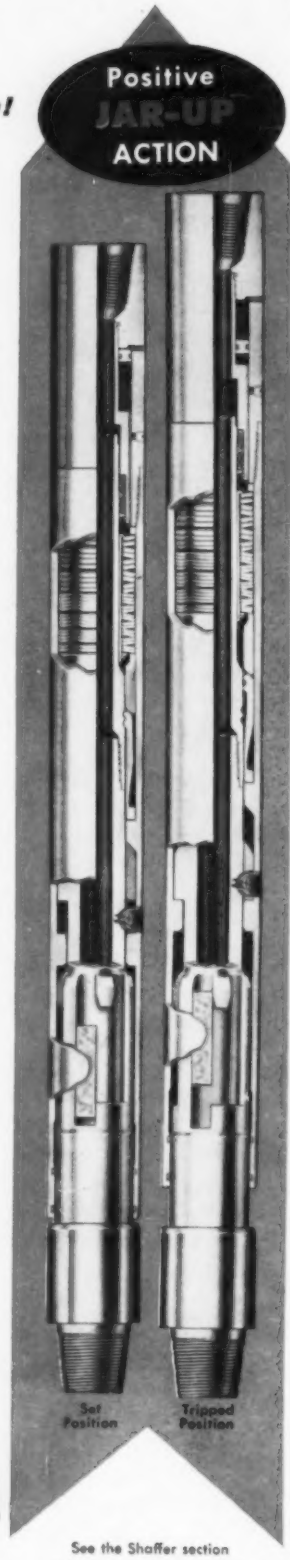
▶ **ONLY STRAIGHT PULL** is necessary to operate the tool—no torque or other secondary operations to affect the light connections commonly used in fishing, testing and coring strings.

▶ **TO RELEASE,** in the event the fish or stuck string cannot be loosened, simply trip the tool and apply reverse torque as the string is slowly lowered. Only one-sixth turn of the drive keys rotates them into an unlocking slot whereupon raising the string allows the parts to unlock.

AND NOTE THIS—not only does the tool transmit full torque loads in *either* direction, but no threads are used in the releasing mechanism. Therefore there's no risk of torque over-tightening the tool—nor can reverse rotation accidentally release it.

Also, force of the blow is absorbed by integral knocker heads—not by easily damaged drive keys or threads. The tool is designed for *sustained* jarring operations. And since it does not depend upon friction for its tripping action, the Jar Safety Joint always operates with the same pre-set action. Light strings are not subjected to unpredictable loads!

Free 8 page booklet gives many other facts about the Shaffer Oil-Sealed Jar Safety Joint. Write for it—or ask your nearest Shaffer representative.



See the Shaffer section of your Composite Catalog.

Exploration

LOUISIANA

Block 75, Vermilion Test Begins

Cities Service has been named operator of a jointly-owned offshore test well being drilled in 22 ft of water in the Louisiana tidelands. The test, known as OCS 0170 (S/L 1443) No. 1, is located 8500 ft east and 1320 ft south of the northwest corner of Block 75, Vermilion Parish. The Miocene formation will be the objective of the 10,000-ft test. It is 17 miles offshore and its location is nearly four miles southeast of gas production in Block 67 and approximately three miles northeast of gas production in Block 76. Cities Service holds a 25 percent interest in the test and is operator. Other interests are held by Tidewater and Lloyd and White. The group has 6248 acres in the area.

Madison Parish Test Spuds

Spudding in is the Singer Manufacturing Company No. 1 well in Section 3, Township 15 N, Range 11 E, Madison Parish, to be drilled by Rimrock Tidelands, Inc., under contract with Sinclair Oil and Gas Company. To be drilled to a depth of 8000 ft, the exploratory well is located near three Continental Oil Company wells which were drilled on the Singer Manufacturing Company fee. W. E. Montgomery, toolpusher on Rimrock's rig No. 9, will be in charge of drilling operations.

OKLAHOMA

Deeper Gas for Hugoton

The year-end completion of Cities Service's third significant Morrow sandstone gas well in Texas County confirms deeper pays under parts of the shallow Hugoton gas fields.

The deeper pay was first indicated in Cities Service's Murdock No. 1 test in the center NE SW Sec. 10-4N-15ECM, when commercial gas shows were indicated in Morrow sandstone tests. Completion of this test was held up pending information obtained from confirmation and test wells in the area.

Confirmation to the Murdock discovery was completed for a calculated open flow of 205,000,000 cu ft of gas daily from Morrow perforations between 6032 and 6078 ft, after fracing. The confirmation is Welch A No. 1 in the center NE SW Sec. 3-4N-15ECM.

Cities Service has also completed another Morrow test five miles west of the Murdock well. Completion was for a calculated open flow of 32,000,000 cu ft of gas daily. Flow was from Morrow perforations from 6160 to 6388 ft. The latest discovery is Stelzer No. 1, center NE SW Sec. 11-4N-14ECM. In completing the Stelzer, the gas pay was not fraced.

Exploration

Pan Am Plugs Deep Grady 'Cat

Pan American Petroleum Corporation's first deep wildcat in the Knox district of Grady County has ended in failure at its No. 1 Mitchell Unit, located in NE NE SW of 34-3n-5w. The well was dry and abandoned at a total depth of 17,004 ft. The failure is north of British American's No. 1 Kreiger, just across the line into Stephens County, which was recently completed as the state's deepest producing well.

3 New Finds for Panhandle

Panhandle Eastern Pipe Line Company has chalked up three new discoveries in Texas County.

The company's Reiss No. 01 found the Upper Morrow productive at 4456 and 4470 ft, flowing 648 bbl of oil and 4,060,000 cu ft of gas per day. The company has 3500 acres around this test.

Panhandle's Keenan No. 02, in the center of its 35,000 acre Fox Block, tested 1290 bbl of oil per day through Lower Morrow sand perforations between 6454 and 6466 ft.

The Easterwood No. 02 flowed oil on test of the Lower Morrow at the rate of 240 bbl per day from perforations between 6049 and 6413 ft. This discovery is also on a 35,000 acre block in Texas County.

Basal Oil Creek Find in Coal

Atmar Drilling Company, Wico Oil Company and Associates have received discovery allowable for their No. 1 Lafever in Coal County. The well, in SE SE NE of 3-2n-8e, is three miles north of the Northwest Tupelo field, and has been completed in the Basal Oil Creek sand with perforations at 4754-62 ft. Total depth of the well was 4825 ft, with 7-in. casing set on bottom. Well swabbed an official 120 bbl of 40 deg oil with a trace of water in 24 hours. Shows were also tested in the Cromwell with the well making 10,000,000 cu ft of gas per day through the drill stem at 3146-95 ft.

NEW MEXICO

New Four Corners Gasser

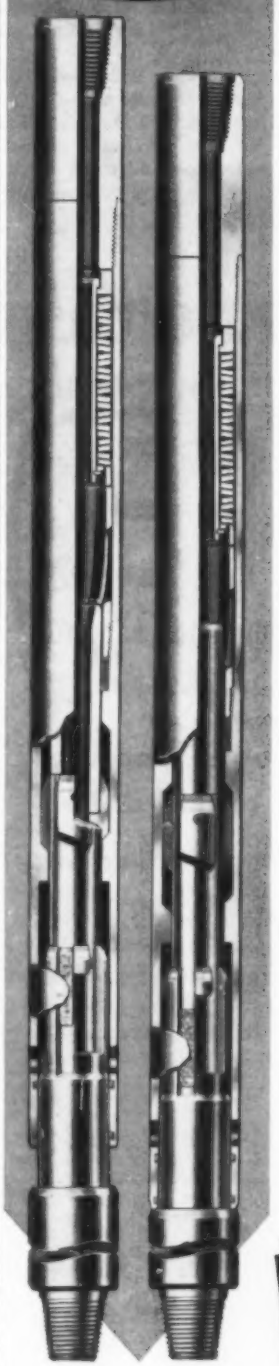
Lion Oil Company, a division of Monsanto Chemical Company, has completed the Vierson No. 1 as a gas discovery well in San Juan County. The wildcat tested 6,000,000 cu ft of gas per day through a ½-in. choke, with flowing tubing pressure of 940 psi. Total depth was 6240 ft with completion in the Dakota formation through perforations from 5974 to 6070 ft.

The discovery well is located six miles northwest of Farmington, in Section 19, township 30N, range 13W. The company owns leases on approximately 1000 acres in the immediate area.

For running in the drill string . . .

Positive JAR-DOWN ACTION

...plus Safety Joint protection!



See the Shaffer section of your Composite Catalog.

THE SHAFFER-WAGGENER BUMPER SAFETY JOINT

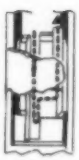
There is no other tool like the Shaffer-Waggener Bumper Safety Joint. It combines—in ONE tool—a choice of *jar-down* and *releasing* actions, both under complete control of the operator. What's more, the tool is so rugged it is run as part of the drill string to protect against stuck pipe.

In actual well service it has operated easily at depths below 18,000 feet, and has given no operating problems even in directionally-drilled wells with extreme slant.

Jar-Down Action

▸ **RUN IT IN THE DRILL STRING**—It is specifically designed to withstand the continuous vibration and heavy torque loads of today's drilling operations.

▸ **TO JAR DOWN** whenever the drill pipe threatens to stick—or to drive drill collars out of keyseats and to free "balled-up" bits—simply slack off weight equivalent to about 2,000 feet of drill pipe onto the tool. This releases the tripping mechanism, automatically striking a sharp *down* blow. Raising the string automatically re-sets the tool for another blow—and blows can be struck repeatedly as fast as the string can be raised and lowered. And no torque or twisting strains are placed in string!



Releasing Action

▸ **TO RELEASE,** in the event jarring will not loosen the stuck string, simply trip the tool and apply reverse torque as the string is slowly raised. Only one-sixth turn of the tool rotates the drive keys into unlocking slots so that complete release is effected by continuing to raise the string.

ANOTHER ADVANTAGE—the tool transmits full torque loads in *either* direction through three rugged drive keys—not through easily-damaged threads. It is the strongest joint in the string—not the weakest, as with conventional safety joints.

Also, the tool can be re-connected again by simply lowering the top portion over the lower portion and reversing the releasing action. It is ideal for use in fishing strings!

Free 8 page bulletin gives the full story on the Shaffer-Waggener Bumper Safety Joint. Write for it—or ask your nearest Shaffer representative.

Exploration

WASHINGTON

Stancal Quits Third

Standard Oil Company of California, Western Operations, Inc., has abandoned drilling operations at its exploratory well in the Rattlesnake Hills of Benton County, Eastern Washington. The wildcat well is located 20 miles north of Prosser (Sec. 15, T11N, R24E) and was drilled to a depth of about 8400 ft.

Company spokesmen stated that six months drilling through volcanic rock formations had revealed nothing of commercial significance. Expenditures to date on the well, exclusive of initial geological work and lease acquisition costs, total approximately $625,000. Numerous special techniques were employed in attempts to speed penetration and all available modern oil and gas detection devices were constantly in use to insure that nothing was missed.

The well, known as Rattlesnake Hills Unit No. 1, was designed to test a large block of more than 100,000 acres. Rattlesnake No. 1 is the latest of three recent attempts by Standard to develop oil or gas production in Eastern Washington and Oregon. None has been successful.

Drilling contractor was Miracle-Wooster of Vernal, Utah.

More Tests for State's First

Sunshine Mining Company's No. 1 Medina, the state's first commercial oil well, has been killed and testing of other possible productive zones is underway. The well, in SW SE NW of 15-18n-12w in Grays Harbor County, produced for several days from the Nye zone of the Lower Miocene at 3952-58 ft. Intervals at 4060-65 ft, 4070-76 ft and 4085-91 ft are to be tested. Well was bottomed at 4135 ft.

Sunshine's second well, the No. 2 Medina, has been stopped in the Ocean City zone at 3016-36 ft. Well flowed from this section. Two additional locations for future wells have been prepared to firm up the discovery area.

SAUDI ARABIA

Second Field for Aramco

The Arabian American Oil Company has indicated discovery of a second offshore oil field. In a drillstem test, oil was found in a wildcat well known as Manifa No. 1, located in the Persian Gulf about eight miles off the coast of Saudi Arabia and 120 miles northwest of Dhahran, Aramco's headquarters.

Aramco's first offshore oil field is the Safaniya field north of Manifa in the Persian Gulf. It went into production in April 1957. The Safaniya field, which is also the first offshore development in the Middle East, had produced approximately 19,117,000 bbl by the end of November.

The Manifa discovery was made in an interval tentatively identified as the Arab "A" member of the Arab Zone. A drillstem test between 8747 and 8794 ft brought gas to the surface in 3 minutes and oil in 20 minutes. Preliminary tests indicate the crude oil has a corrected gravity of 28 deg API and is sour. Seven-inch casing was set at 8730 ft before the test. Coring of the Arab Zone is now being concluded. In the Sulaiy limestone just above the anhydrite cap rock of the Arab zone, oil shows were encountered also. Production possibilities of this limestone are yet to be determined.

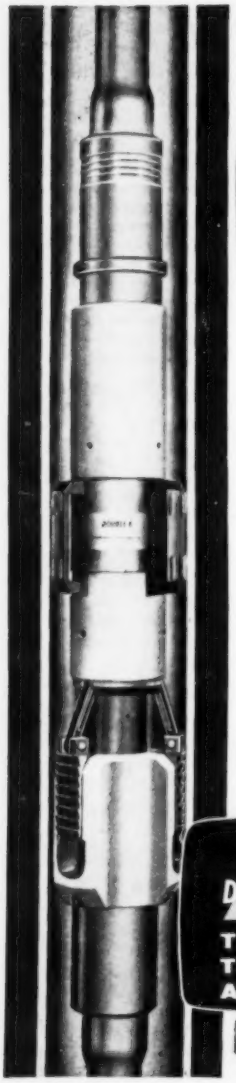
Drilling of Manifa No. 1 began on September 30, 1957. It was drilled with the Queen Mary, Aramco's 174-ft drilling barge.

The upper and lower sands of the Bahrain zone, productive in the Safaniya field, had been found unproductive in Manifa No. 1. Drilling was continued into the Arab zone, where oil was encountered.

(Continued on Page B-123)

NOW—CUT PUMPING COSTS

With The Finest Tubing Anchor in The Business . . .



SAFE!

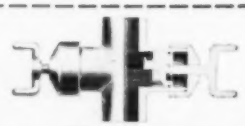
FIELD-PROVEN in HUNDREDS OF WELLS

The Double-E Tension Tubing Anchor

Cuts pumping costs drastically; improves pumping efficiency dramatically. Installs quickly, easily. Retrieving is sure and completely safe. Write for details now.

ORDER DOUBLE-E TOOLS AT YOUR SUPPLY STORE

DOUBLE-E TENSION TUBING ANCHOR

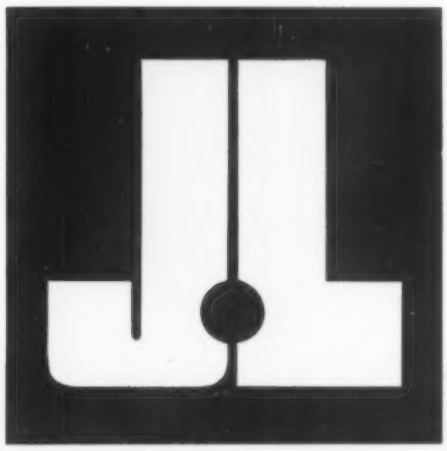


ANOTHER FINE DOUBLE-E PRODUCT THIS STRONG, SIMPLE BLOWOUT PREVENTER

EQUIPMENT ENGINEERS, Inc.
2039 Amelia St., Dallas 35, Texas LAkeside 6-3873

TUBING CATCHERS • SWABS • ANCHORS • PACKERS • ROD & WIRE LINE STRIPPERS

FOR FURTHER INFORMATION ON
ADVERTISED PRODUCTS, SEE READER SERVICE CARD



NOW . . . ANOTHER GREAT NAME

ADDED TO THE GARDNER-DENVER TEAM

SERVING THE PETROLEUM INDUSTRY

GARDNER-DENVER COMPANY

JONES & LAUGHLIN SUPPLY DIVISION

CONTINENTAL-EMSCO COMPANY

Gardner-Denver Company is broadening distribution of its line of pumps to the petroleum industry through addition of the field outlets of Jones & Laughlin to the outlets of Continental-Emsco Company.

Appointment of Jones & Laughlin as co-distributors with Continental-Emsco Company, throughout the United States (except California) and Canada, assures Gardner-Denver oil field customers of outstanding service and fast deliveries.

ENGINEERING FORESIGHT—PROVED ON THE JOB
IN CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

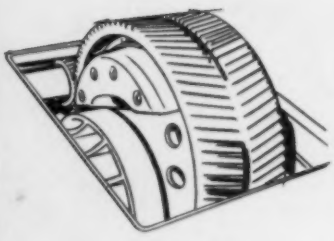
GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois

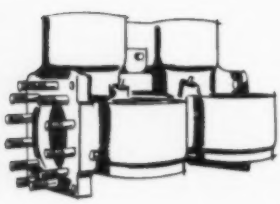
GARDNER-DENVE

...quality lead

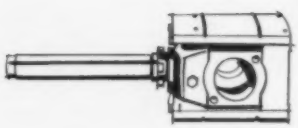
Five GX models availa with horsepower rating 350, 500, 625, 1000 and 1



Eccentric Construction. Eccentric construction results in large bearing area and low bearing pressures. Easily withstands high plunger loads from deep well drilling and jet bits.



Divided Fluid Ends. The famous Gardner-Denver divided fluid end construction reduces cylinder replacement costs. Interchangeable right- and left-hand cylinders simplify parts stocks.



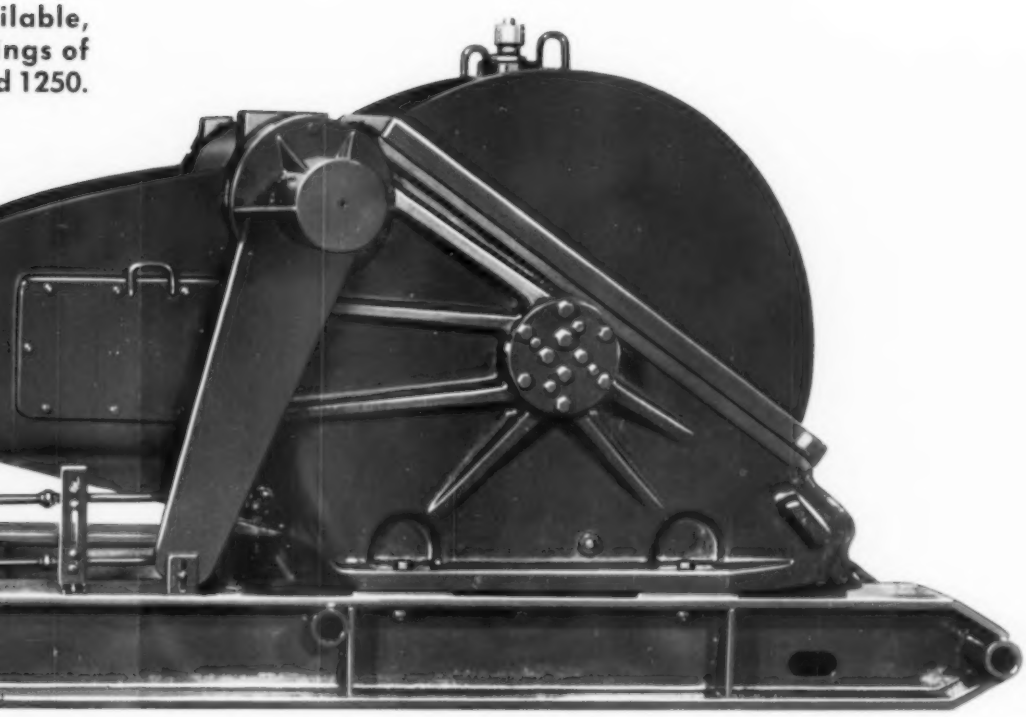
Unusual acc ty. All rep parts on the G Denver pu readily acces can be repl the field.

One-Piece Connecting Rods. Gardner-Denver one-piece connecting or eccentric rods eliminate the danger of bolts working loose during operation.

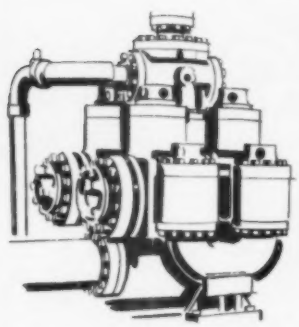
ER GX MUD PUMPS

ders in the field

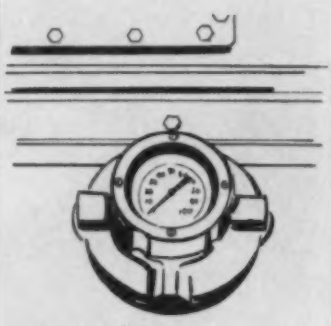
ilable,
ngs of
d 1250.



accessibili-
replaceable
e Gardner-
pump are
ccessible —
eplaced in



Valves Quickly Reached. Screwed valve pot covers save time on every valve inspection or replacement. On the 1250 hp. GXH, threaded fluid cylinder locks and rings are interchangeable with valve cover locks.



Pressure Lubrication. Positive pressure lubrication in the power end assures full lubrication of all moving parts. Oil stop head keeps oil in . . . mud out.

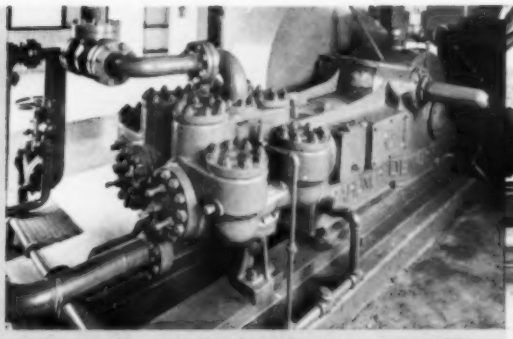
Service Specialists Nearby. Gardner-Denver service specialists are headquartered near every important drilling area to provide expert help on repair or replacement problems.

well drilling and jet bits.

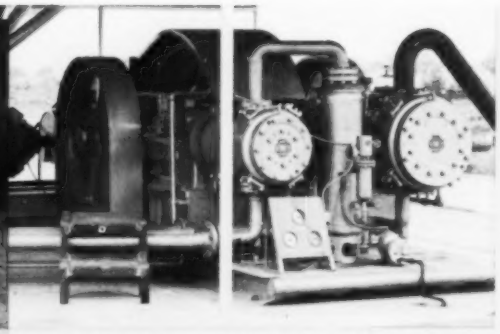
hand cylinders simplify parts stocks.

working loose during operation.

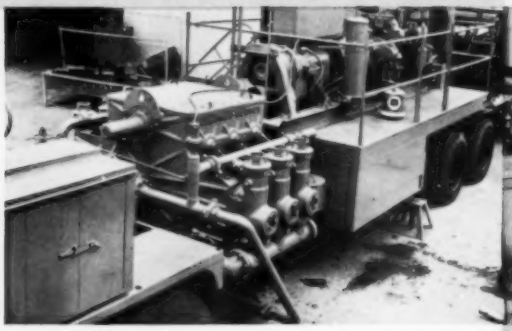
GARDNER-DENVER QUALITY EQUIPMENT FOR THE PETROLEUM INDUSTRY



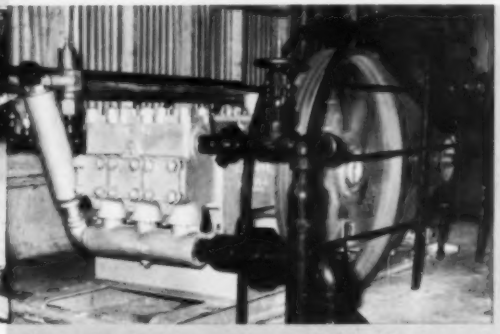
FX Power Pumps. Gardner-Denver rugged FX power pumps for mud, oil line and water supply service. Horsepower ratings from 16 to 255.



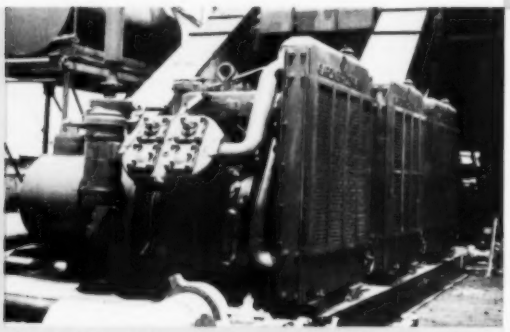
Gas Compressors. Complete units for repressuring, boosting, air-gas lift. Wide range of capacities and pressures for most field conditions.



Well Servicing Pumps. For high pressure cementing, acidizing, fracturing, work-over service. Four models—pressure range to 10,000 psi.



Waterflood Pumps. For waterflooding or salt water disposal. Six models—pressures to 3360 psi.—capacities to 13,200 bbls. per day.



Air Drilling Compressors. Air and gas units engineered to meet requirements of air drilling and mud aeration under various conditions.

Also:

Expendable Mud Pump Parts
Steam Pumps for Boiler Feed and General Service
Centrifugal Pumps for Water Supply and General Use
Air Compressors for Engine Starting, Rig Use and General Air Service
Rotary Portable Air Compressors
Pipeliners' "Quadril"*
Pipeliners' "Twindril"®
Rock Drills and Air Tools
Air Hoists and Air Motors
Portable Air Drills and Tools

*Trade-Mark

GARDNER-DENVER Since 1859

ENGINEERING FORESIGHT—PROVED ON THE JOB
IN CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois

changeable with valve cover locks.

Exploration

NORTH DAKOTA

Anchutz Hits 23 Miles from Production

Tests are underway for a discovery by Anchutz Drilling Company in Renville County at its No. 1 Christensen, which spots 23 miles southwest of the Newburg pool in Bottineau County. The rank wildcat, in C NE NW 7-158n-81w, indicated 1000 ft of heavily gas-cut oil and 90 ft of slightly-mud cut and heavily gas-cut oil on a drill-stem test of the Lower Mission Canyon at 4466-79 ft. This zone was topped at 4360 ft.

A 9 ft core taken at 4479-99 ft showed even saturation in fragmental, oolitic, vugular limestone and yielded a good sweet odor. The well is east of the Nesson anticline and is located in the North Dakota Basin on a trend due south of the Virden field of Manitoba province of Canada.

Outposts Dot U. S. Border

One of the most promising wildcats that now dot the U. S.-Canadian border in several North Dakota counties is a Burke County test drilled by Petroleum Corporation of America and Tom Jordan. The well, when completed, would place production within one mile of the border and give the area its first producer from the Three-zone of the Mission Canyon formation. The No. 1 Mamie Ballintine, in NE, NW of 6-163n-91w, flowed 8 bbl per hour through ½-in. choke on initial test. Oil came from a perforated zone at 5881-86 ft. A second test of the same interval yielded 11 bbl per hour on a ¾-in. choke, testing for 9½ hours.

TURKEY

Gulf Assigned Feldman Leases

Turkish Gulf Oil Company (a new Gulf Oil Corporation subsidiary), and D. D. Feldman Oil & Gas, Inc., of Dallas, Texas, have received approval of the Turkish Petroleum Administration to conclude an agreement concerning oil exploration in Turkey. Feldman has assigned Gulf an undivided 75 percent interest in 13 oil and gas licenses covering approximately 1½ million acres in several parts of Turkey. Turkish Gulf Oil Company has been incorporated to continue the exploration work undertaken by Feldman, Turkish Gulf becoming the operator on behalf of the two companies.

Feldman also heads Worldwide Petroleum Corporation Ltd. This corporation and its subsidiaries have substantial holdings in Sicily, Switzerland, and France, and in addition have applications on file for permits to explore and drill in the interesting areas of Algeria and Libya.

ALTEN
Pumping Unit Features
OVER-THE-BEAM EQUALIZER
BRONZE SADDLE & EQUALIZER BEARINGS
ADJUSTABLE HINGED HORSEHEAD
EXCLUSIVE MAGNETIC OIL SAVER
HERRINGBONE GEAR REDUCER
TAPERED WRIST PINS
ADJUSTABLE POLISHED ROD HANGER
RUGGED FRAME & SAMSON POST
AUTOMOTIVE BRAKE
SCREW-TYPE ADJUSTABLE COUNTERBALANCE
CHECK THESE ALTEN FEATURES...
they add up to ten reasons why Alten Pumping Units give you more efficient, more economical production. Order your next unit from Alten—specialists in pumping units.
Sold through your Independent Supply Store
ALTEN
FOUNDRY & MACHINE WORKS, INC.
OKLAHOMA CITY, OKLA. • ODESSA, TEXAS
LANCASTER, OHIO

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS SEE READER SERVICE CARD

What's doing in DRILLING

The Ups and Downs of Drilling

A year-end drilling surge which began later than usual ended without reaching customary proportions, rounding out a year of drilling activity which never reached the level of the previous year. According to Hughes Tool Company tabulations, the 1957 drilling activity peak in the United States and Canada was reached on December 16, when there were 2842 rotary rigs in action in the two countries.

Like figures for the two previous years showed 3132 active rigs on December 17, 1956, and 3338 active rigs on December 19, 1955—the latter figure being an all-time high.

Commenting on the 1957 drilling activity lag, Brad Mills, executive vice president of the American Association of Oilwell Drilling Contractors, states in the current edition of *The Drilling Contractor*, official AAODC magazine: "When we weave together such factors as a slightly lower consumption level than expected, questionable economic conditions in many industries, slightly increased oil imports, expanded foreign operations and hesitancy of some large producing companies to meet their full drilling quotas, these combine to give us fewer well completions and less footage during 1957 than in 1956."

Mills further asserts that "while no spectacular increase in drilling operations is expected for next year, it certainly is reasonable to assume that at least the current level of operation should be continued if we are to develop adequate reserves for both normal consumption and such emergencies as may arise."

In a year-end statement, Charles W. Alcorn, president of Texas Mid-Continent Oil & Gas Association, stated that a number of "sizable" Texas oil operators have advised him they will hold 1958 drilling to "about the 1957 rate or below." Some individual companies indicated they might cut back as much as 10 or 15 percent.

Alcorn further commented that although Texas operators will be able to finance a substantial 1958 drilling program if oil production and prices hold at present levels, the coming year will call for caution and self-restraint in production, refining and development drilling with the very economic health of the oil industry at stake.

Texas Firm Enters Guatemala

Coastal Plains Oil Company of Houston has announced that it has loaded more than 100 tons of drilling equipment on a steamer bound for Guatemala, where the firm has a 48-million-acre concession.

A. F. Lavender, Coastal Plains president, said the company plans to launch exploratory operations in Guatemala shortly.

Aramco Discovers New Field

Arabian American Oil Company has reported discovery of a second offshore oil field in the Middle East. In a drillstem test, oil was found in an exploratory well known as Manifa No. 1, located in the Persian Gulf about eight miles off the coast of Saudi Arabia and 120 miles northeast of Dhahran, Aramco's headquarters.

The Manifa discovery was made in an interval tentatively identified as the Arab "A" member of the Arab zone. A drillstem test between 8747 and 8794 ft brought gas to the surface in three minutes and oil in 20 minutes.

Falcon Christens Inshore Barge

Levingston Shipbuilding Company of Orange, Texas, recently completed another submersible drilling barge. The vessel was built for the Falcon Seaboard Drilling Company and named the "Theo N. Law" in honor of the president of the company.

This giant drilling barge measures 220 ft long and 52 ft wide. Equipment installed aboard will permit deep well drilling beyond 22,000 ft. The 140-ft derrick has a capacity of 1,100,000 lb. Another feature of the "Theo N. Law" is the all steel helicopter landing deck which has been installed on the top of the living quarters.

The vessel was christened in a short ceremony at the docks of the Jack Tar Orange House in Orange. Immediately following the ceremony the barge left for its first drilling location in Audubon Game Reserve in Vermilion Bay, where it will operate in 9 ft of water and drill to a depth beyond 15,000 ft.

Oil Company Leases City Street

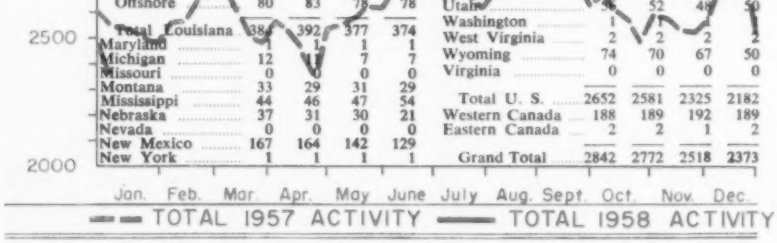
Richfield Oil Corporation, which already holds substantial oil and gas leases within the corporate limits of Fillmore, California, has been awarded still another — this one covering 2020 acres comprising a city street. The Fillmore City Council has approved leasing of Old Telegraph Road to Richfield for $400 per month per acre, plus one-fifth of all oil and gas found. Lease provides for slant drilling from other property.

A large part of urban property in Fillmore has already been leased for oil and gas exploration and development. Leases now cover town lots, school yards, the property upon which the city hall stands — and now even a city street.

Rotary Rigs Operating in Oil Fields of United States and Canada

As reported to American Association of Oilwell Drilling Contractors by Hughes Tool Company

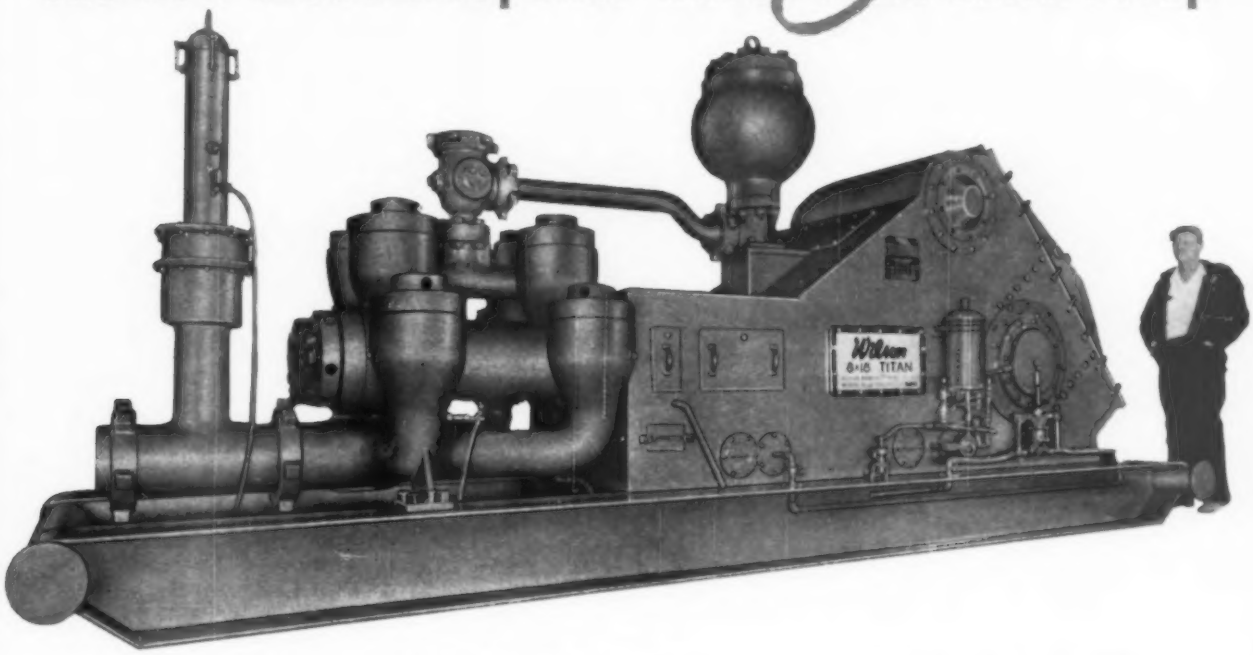
	Dec. 16	Dec. 23	Dec. 30	Jan. 6
Alabama	9	9	8	8
Arkansas	26	23	16	18
Arizona	1	1	1	0
California	100	99	94	91
Colorado	42	39	35	33
Florida	1	1	1	1
Georgia	0	0	0	0
Idaho	0	0	0	0
Illinois	52	49	30	44
Indiana	11	10	4	3
Iowa	2	2	2	2
Kansas	177	165	138	118
Kentucky	15	8	6	8
North Louisiana	40	47	39	35
South Louisiana — Land	264	262	260	261
South Louisiana — Offshore	80	83	78	78
Total Louisiana	384	392	377	374
Maryland	1	1	1	1
Michigan	12	11	7	7
Missouri	0	0	0	0
Montana	33	29	31	29
Mississippi	44	46	47	54
Nebraska	37	31	30	21
Nevada	0	0	0	0
New Mexico	167	164	142	129
New York	1	1	1	1
North Dakota	50	51	47	43
Ohio	1	1	1	1
Oklahoma	270	248	227	220
Oregon	0	0	0	0
Pennsylvania	9	8	8	7
South Carolina	0	0	0	0
South Dakota	1	1	1	1
Tennessee	0	0	0	0
Texas Gulf Coast — Land	227	244	215	191
Texas Gulf Coast — Offshore	6	4	2	3
West Texas	405	373	352	335
North Texas	365	369	324	285
East Texas	70	76	59	51
Total Texas	1073	1066	952	865
Utah	56	52	48	50
Washington	1	1	1	1
West Virginia	2	2	2	2
Wyoming	74	70	67	50
Virginia	0	0	0	0
Total U. S.	2652	2581	2325	2182
Western Canada	188	189	192	189
Eastern Canada	2	2	1	2
Grand Total	2842	2772	2518	2373



Announcing

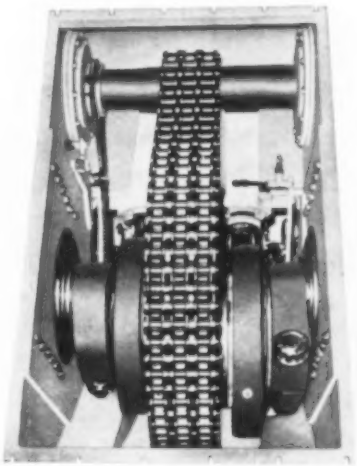
Tomorrow's Pump Today

The New 1250-Horsepower Wilson Titan Slush Pump



Think of it! A 1250-H.P. pump that weighs ONLY 35,300 lbs. complete with pistons, rods, liners, valves, skids and Suction Flow Equalizer. Half the weight of a conventional pump! — 28 lbs. per horsepower! Far less initial cost per horsepower. Far less upkeep! Every modern feature: • Chain drive • Welded steel frame • Alloy steel mud end • Quickly removable valve covers • Quickly removable cylinder heads • Works efficiently from 600 to 1250 horsepower. Write for special bulletin.

BE MODERN - BUY WILSON

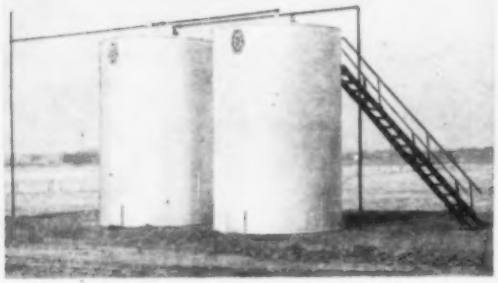


Wilson revolutionary CHAIN DRIVE means NO GEARS!

WILSON MANUFACTURING CO., INC.

Wichita Falls, Texas, U.S.A. — The Home of Red Iron

A WISE CHOICE



M&V Welded Lease STORAGE TANKS

M & V Tanks represent the most rigidly high standards of design, materials, and workmanship. Vapor tight without inspection or maintenance, they are outstandingly permanent and trouble-free.

Relivery and installation are fast and dependable. A complete stock is maintained. M & V Tanks are a wise choice!

MFD BY M&V TANK COMPANY — M & V — WICHITA FALLS, TEXAS

TREATERS-SEPARATORS-TANKS
Steel Fabrication for the Oil Industry

NESNEJ or JENSEN

14 sizes 22 models

No matter how you look at a Jensen Jack it always seems to spell better profits on production records. For a lot of Jensen customers it has been this way for 39 years — ever since Jensen started in business in 1919. Every day more and more hard-to-convince oil men are seeing the light and standardizing on Jensen Jacks, because to them "profit" is now spelled "JENSEN."

Well?

If you are producing wells, and they're not Jensen equipped . . . Mister, you're just doin' yourself a dirty trick. Better investigate, but pronto!

STOCKED BY YOUR LOCAL SUPPLY STORE

Made By

JENSEN BROS. MFG. CO., INC.

P. O. Box 477-B
Coffeyville, Kansas, USA

Export Office:
60 East 42nd St.,
New York, N. Y.

JENSEN JACKS

Drilling

Rock Bit Manufacturers to Organize

Plans are underway for formation of a national Association of Rock Bit Manufacturers, Joe Cowan, Fort Worth advertising executive, has announced.

Cowan, who has had 10 years experience in sales promotion and advertising for rock bit manufacturers, in announcing the plans said: "Serious problems are confronting the rock bit manufacturers today that can be eliminated by cooperative efforts on an industry-wide basis."

After consulting with several major manufacturers who expressed a need for such an organization, the following objectives were announced: (1) Develop a well-planned public relations program for the industry, (2) provide central organization for technical and industry-wide information, (3) develop sales aids and helps for better merchandising techniques, and (4) develop publicity on members of the association.

Russian Rigs Drill in Hungary

Delivery of 15 modern Russian rigs is enabling Hungary to make sharp gains in exploratory drilling, according to the Soviet newspaper *Pravda*.

In a report from Budapest, *Pravda* said that oil has been found at three locations north of Nagylengyel — Hungary's largest field near the Yugoslav-Austrian border. It added that test drilling in the Szolnok area in east-central Hungary and at Toertel has yielded oil.

Hungary is trying to bring petroleum production back to the record 1,601,000 metric tons achieved in 1955. Output fell to 1,200,000 metric tons in 1956 as a result of the anti-Communist revolt.

Safety Accents Offshore Drilling Island

An unusually high number of oil wells planned for a single offshore drilling "island" in California caused officials of the Monterey Oil Company to plan and adopt equally unusual safety measures for the protection of platform personnel and highly valuable property.

Top safety measures for what will eventually be a 70-well operation include:

1. Water tight doors opening to a catwalk surrounding the ocean side of the island.
2. Permanent openings to the platform's wharf side.
3. Two gas alarms for the detection of dangerous inflammable gas concentrations.
4. Foam piping and fog fire extinguishers with permanent overhead nozzles for cellars and other key platform points.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Drilling

Australia Invites Oil Companies

The Australian government has set aside $1,120,000 annually for the next four years to encourage drilling to obtain stratigraphic information. Subsidies are granted to oil companies willing to drill in areas not previously explored at depth. Each subsidy will be limited to not more than one-half the cost of the hole. Oil companies have responded well to the offer and applications are now being studied.

Offshore Platforms Movie Available

R. G. LeTourneau, Inc., has announced availability of a new 18-minute movie entitled "Three Legged Islands" showing construction and operation of LeTourneau-built offshore platforms.

The two principal platforms discussed in the movie are the "Scorpion," which recently set a time record for relocation activity in the Gulf of Mexico, and the "Vinegarroon" which weathered hurricane Audrey with virtually no damage. Three others also are shown during construction stages.

The 16 mm sound movie is available for showings to petroleum groups without charge. Write to: R. G. LeTourneau, Inc., 2399 South MacArthur, Longview, Texas.

Tennessee Gas Forms Overseas Office

Tennessee Gas Transmission Company, following completion of a Venezuela wildcat in which it has an interest and start of drilling by a subsidiary on a Bolivian lease, has formed an overseas department to direct its exploration and production activities outside North America. The company's Venezuelan activities are conducted through a wholly-owned subsidiary, Tennessee-Venezuela, S. A., which holds an interest in 1969 acres of Lake Maracaibo concessions on which a 5760-bbl per day well was recently completed.

Stuart P. King, for the past three years a director and general manager of Merrill Petroleums Ltd., of Calgary, Canada, has joined Tennessee Gas as manager of the new overseas department.

New Depth Contender in Texas

Phillips Petroleum Company is nearing the state's depth record of 21,687 ft, set not so long ago by Pan American Petroleum Corporation. Both wells are in Pecos County. New contender is Phillip's No. 1-EE University in Section 7, Block 24 of the University Lands Survey. This well is reported drilling below 21,207 ft in lime and shale.

HYCALOG

ANNOUNCING

"Qual" and "Quan" gas analysis... newest development in well logging. Another dividend you receive from Hycalog's continuing research program.

at no extra cost!

HYCALOG GAS CHRONOFRAC

Patent Pending

Now available in both Hycalog well logging units and gas recorders.

You get qualitative and quantitative analysis of gas samples . . . *at the well* . . . with HYCALOG GAS CHRONOFRAC analysis. The important gases . . . methane, ethane, propane, and butane . . . are immediately identified, measured, and recorded.

No comparable technique for field use has ever been developed except the SPECTRA-SCAN portable mass spectrometer . . . *also pioneered by* HYCALOG. And yet GAS CHRONOFRAC analysis costs no more than conventional field methods.

Write for free technical bulletin.

Hycalog, Inc.

505 AERO DRIVE
SHREVEPORT, LOUISIANA

DIAMOND CORING • DIAMOND BITS • WELL LOGGING • CORE ANALYSIS

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

RUNNING TOUR with MEN in the INDUSTRY

Ralph E. Damp has been named manager of production and exploration of American Petrofina, Inc. Damp will be in charge of all production and exploration activities of American Petrofina and will headquarter in New York. Damp formerly was an independent oil consultant.

R. E. Damp

P. L. Dana

Philip L. Dana has been elected vice president of J. M. Huber Corporation. His election as head of the company's oil and gas division, located at Borger, Texas, fills the vacancy left by the death of C. Earl Blackburn on November 25. Dana previously served as chief geologist and assistant to the vice president, oil and gas division. He has been with the company since 1944.

Standard Oil Company of California has announced several key personnel changes in its Southern California, Utah, and Alaska producing operations. Some of the moves are a result of expanding Standard activities in Alaska. **W. H. Cochems,** formerly assistant southern division production superintendent at Murphy-Coyote, has been appointed production superintendent there, succeeding **C. N. Beyrle,** who has retired January 1 after 36 years of service. Cochems will be succeeded by **M. E. Kinnebrew,** formerly production foreman at Kettleman Hills. **J. T. Crooker** has been named district superintendent, Alaska, with headquarters at Anchorage. He will be joined there by **R. L. Beckwith,** former staff engineer, producing, San Francisco, who will handle general engineering matters for Alaska operations. Crooker's office assistant will be **R. E. Vanderwall,** formerly a specialist at Murphy-Coyote. Other Alaska asignments include **W. E. Whitney,** engineer-development, who leaves the same post at Red Wash, Utah. **C. V. Chatterton** has been named district superintendent for Red Wash. He has been acting district superintendent for several months.

S. C. Stoneham was appointed staff seismologist for Standard of California, Western Operations, Inc., with headquarters at Oildale, California. In the newly-created post, Stoneham will have charge of developing new interpretation techniques and reviewing existing methods of seismic interpretation.

Five top appointments in the production department of The California Company have been announced. **J. O. Sanders** is promoted to assistant general manager of the production department, succeeding **E. J. Deu Pree.** Formerly superintendent of Calco's Delta-Gulf Coast production division in Harvey, Louisiana, Sanders will be headquartered in New Orleans. **R. E. France** replaces Sanders, moving from his post as superintendent of the South Louisiana production division also at Harvey. **D. D. Jackson Jr.** will move from Natchez, Mississippi, where he has been superintendent of the company's North Louisiana-Mississippi production division, to Harvey as superintendent of the South Louisiana division. **C. L. Pickett** will succeed Jackson in the superintendency at Natchez. He has been superintendent of Calco's Western production division with headquarters in Denver, Colorado. **L. C. Soileau** returns to Calco from a foreign assignment as vice president and director, producing, for the Richmond Exploration Company in Venezuela, to become superintendent of the Western division in Denver.

Helmerich & Payne, Inc., wholly owned contract drilling subsidiary of White Eagle Oil Company, Tulsa, has announced the appointment of **Carl H. Young** as assistant to the vice president in charge of drilling operations. He will assist in the direction and coordination of the company's field operations.

C. H. Young

F. A. Garb

Forrest A. Garb, petroleum engineer, has joined H. J. Gruy and Associates, petroleum consultants. For the past 2 years he has served as a reservoir engineer in Socony Mobil's Eastern Venezuela division.

Pete DeFrank has been named manager of the new perforating flow laboratory at Jet Research Center, Inc., at Arlington, Texas. He was formerly with Welex, Inc., and joined Jet Research Center shortly after that firm's organization in late 1955.

Earl M. Kipp, director, vice president and assistant to the president of The California Company, has been transferred to Standard Oil Company of California. Kipp, who has been a leader in Louisiana engineering and oil industry work, will become special consultant—producing problems on the staff of the vice president in charge of producing for Standard of California in San Francisco. His successor will be announced in the near future.

E. M. Kipp

W. A. Strauss

Willis A. Strauss has been named administrative vice president of Northern Natural Gas Company. His promotion was from director of the company's certificate department to the newly created position. In his new capacity he will assist the president in keeping in touch with and coordinating the various operations of the company. He will continue to supervise the activities of the certificate department. In addition, he will also become a member of the company's management board.

Z. C. Ambrose has been named president of Associated Oil & Gas Company. He has been assistant president of the company since August 1954. **H. J. Mosser,** who has been president of Associated, was advanced to chairman of the board of directors. **D. C. Bintliff,** formerly executive vice president, was named vice chairman of the board.

The directors created an executive committee composed of Ambrose, chairman; Mosser, Bintliff, **J. G. Taylor** and **A. W. George.**

Gerald W. Flowers (center) of Baytown, Texas, receives from John G. Pew of Philadelphia, Pennsylvania, Sun Oil Company vice president for production, the J. Howard Pew Award for his "act of heroism beyond the call of duty" in dragging two men—one more than twice his weight—from certain death inside a crude oil storage tank at San Leon, Texas. Three officials of Sun's Gulf Coast division at Beaumont, Texas, watch as he receives the plaque and gold watch. From left to right are division operating superintendent, Donald D. Braugh, Pew, Flowers, division manager Donelson Caffery, and division industrial relations manager L. T. Butler. Other awards Flowers has received can be seen on the table in the foreground.

DEPT/Exploration, Drilling, Production
Edwards Deep Test Stirs Interest
EXPLORATION
Outlook—First Step in Williston's Comeback
By John C. McCaslin
TEMPERATURE BARRIER BROKEN by Ginther, Warren & Ginther KILLAM WILDCAT at Pescadito Salt Dome
Huge Salt Dome Found
Wildcat confirms Pescadito structure near Laredo as big dome. It extends great Southwest Texas salt basin 35 miles west and opens up exciting oil possibilities
PESCADITO SALT DOME
HOUSTONIANS' TEST IN WEBB SETS RECORD
Ginther, Warren & Ginther of Houston
Pescadito test looks good as . . .
Huge Salt Dome Yields Gas

Ginther, Warren & Ginther's confirmation of the deep Pescadito salt dome at Laredo is the most exciting geological performance in Texas this year.

DMS® MUD USED

Low-sodium DMS surfactant mud gave trouble-free performance, despite a record bottomhole temperature of 460°F at 14,552 feet. This is even more remarkable since the mud was subjected to numerous gas kicks and contaminated by drilling more than 700 feet of solid salt in the bottom of the hole.

COST: Contrary to expectations, the low-sodium DMS surfactant mud used costs no more than an ordinary mud of equivalent weight.

SERVICE: Magcobar programmed and serviced this low-sodium DMS mud designed for high-temperature drilling. Magcobar is prepared to assist in planning trouble-free DMS surfactant muds for the deeper, hotter holes which will open new producing horizons.

Contact Magcobar, using this coupon, for the complete information bulletin on DMS surfactant muds.

ANTARA gaf

From Research to Reality

ANTARA CHEMICALS
A SALES DIVISION OF
GENERAL ANILINE & FILM CORPORATION
435 HUDSON STREET • NEW YORK 14, NEW YORK

MAGCOBAR
P.O. Box 6504, Houston 5, Texas

Please send me your DMS surfactant muds Bulletin.

Name..... Title.....

Company.....

Address.....

City..... State.....

B and W Inc.
A Good Combination for a GOOD CEMENT JOB
B and W MULTIFLEX SCRATCHER
B and W AUTOMATIC STOP COLLAR
B and W LATCH-ON CENTRALIZER

OTHER PRIMARY CEMENTING TOOLS: Hinged Nu-Coil Scratchers • Rotating Scratchers, Multi-Flex and Nu-Coil Types • Automatic Stop Collars • Stabilizers • Rotator Collars • Liner Centralizers.

B and W Inc.
Well Completion Specialists
GULF COAST
Box 5266
Houston 12, Texas
Phone WA 3-6603
WEST COAST
19706 S. Normandie Ave.
Torrance, California
Phone FAculty 1-2463

Running Tour

Gulf Oil Corporation has announced promotions for veteran employees of its production department: **H. B. Leeton,** Houston division petroleum engineer, appointed division production manager,

H. B. Leeton

F. L. Carpenter

Western Gulf Oil Company, and will assume his new duties in Los Angeles, California. **F. L. Carpenter,** district production manager of the Evansville, Indiana, district, has been transferred to Houston as Leeton's successor.

A number of changes have been announced in the drilling and production departments of Kerr-McGee Oil Industries, Inc. **G. Otis Danielson,** formerly regional drilling manager at Morgan City, Louisiana, has been transferred to Oklahoma City and assumes the duties of manager of the drilling department. **Ken W. Parker** has become special assistant to Danielson and will handle foreign operations. **B. D. McCampbell,** contract drilling engineer, transferred from New Orleans to Oklahoma City, will maintain contacts with operators doing exploratory and development drilling in foreign areas and eventually will assume the coordination of similar activities in the Mid-Continent area. **Grier Zimmerman** has replaced Danielson as manager of drilling operations in the Gulf Coast region and **John Cox** has become supervisor of engineering and maintenance for the Gulf Coast.

John Fisher has assumed the duties as representative on outside operated properties. Fisher's duties in this newly created position will be in addition to his work of negotiating gas sales and purchase agreements and the coordination of activities with the Federal Power Commission. New chief engineer in the production department is **Harry Hanna,** recently transferred from Morgan City. **George Girouard** has been named reservoir engineer.

George H. Hirschfeld, engineer with the New Mexico Oil & Gas Engineering Committee for 16 years, has resigned his position and has joined Moran Oil & Drilling Corporation in Hobbs, New Mexico. He will be active in all phases of Moran's contract drilling, leasing and oil producing operations.

J. R. Buck

J. Randolph Buck has joined Northern Natural Gas Company as senior reserves engineer in the reserves and availability section of the gas supply department. Buck has had approximately 20 years experience in the petroleum industry and prior to joining Northern was an independent petroleum consultant in Dallas, Texas.

Prof. Ronald K. DeFord, University of Texas geologist, has been honored with lifetime membership in the West Texas Geological Society at a recent meeting in Midland. In addition to his teaching and research in structural geology of the Southwest, DeFord serves as adviser to graduate students in geology at UT. Of the graduate students he has guided through research, 98 have received master of science degrees and 10 doctor of philosophy degrees in geology. Each summer he supervises field parties of graduate students who explore and make detailed geological maps of areas in the Southwest never before mapped in detail. DeFord is also a consultant for the University's Bureau of Economic Geology. He joined the University staff in 1948, after serving as Argo Oil Corporation chief geologist in Midland for 15 years. Early in his career he worked as a field geologist for Midwest Refining Company, his explorations taking him over West Texas, New Mexico and the Rocky Mountain region.

Fred L. Oliver and **Frank West** have opened consulting offices in Dallas, Texas, operating as Fred L. Oliver & Associates. Oliver leaves DeGolyer & MacNaughton after having spent five years with this company. He previously had worked briefly for Petty Geophysical Company

F. L. Oliver

Frank West

and Robertson Drilling Company, and for Stanolind Oil & Gas Company for over three years.

West will retain his present position of trustee for the estate of J. B. Stoddard. He worked for 5½ years for Continental Oil Company in California, Oklahoma, and Texas. In December, he joined J. B. Stoddard, independent oil operator, as assistant manager and chief engineer. Oliver is 1958 chairman of the Dallas Local Section of AIME; West has been elected 1958 secretary of this group.

J. Paul Roston, former head of the petroleum section in the mining engineering department at the Missouri School of Mines, has joined Alex W. McCoy Associates, Inc., Tulsa, as staff engineer.

SECONDARY RECOVERY
Since 1922
PETROLEUM ENGINEERS
CABLE ENGINEERING
WICHITA FALLS, TEXAS
RESERVOIR ENGINEERING
Water Flooding Gas Repressuring
EVALUATION CORE ANALYSIS
SURVEYS ECONOMICS
Cost Estimates, Design, Installation
FIELD SUPERVISION
Phone 3-2167

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS SEE READER SERVICE CARD

In rotary drilling, pulling a 100-ton, two-mile string of drill pipe subjects the drilling line to the terrific stresses imposed by fast acceleration, shock loads, bending and overwinding on drums. Only wire rope with the highest degree of quality in hardness, strength and fatigue resistance can be used, for toolpushers know that . . .

A quality rope is a safe rope

Whether you use wire rope in the field or in a factory, *safety is just as important to you.* When you buy "bargain" rope you bargain with safety. It can cost you more than the pennies you save. Buy on the basis of *quality*—buy Wickwire Rope.

For extra strength—buy Wickwire's Double Gray IWRC extra improved plow steel wire rope

WICKWIRE ROPE — A CF&I PRODUCT

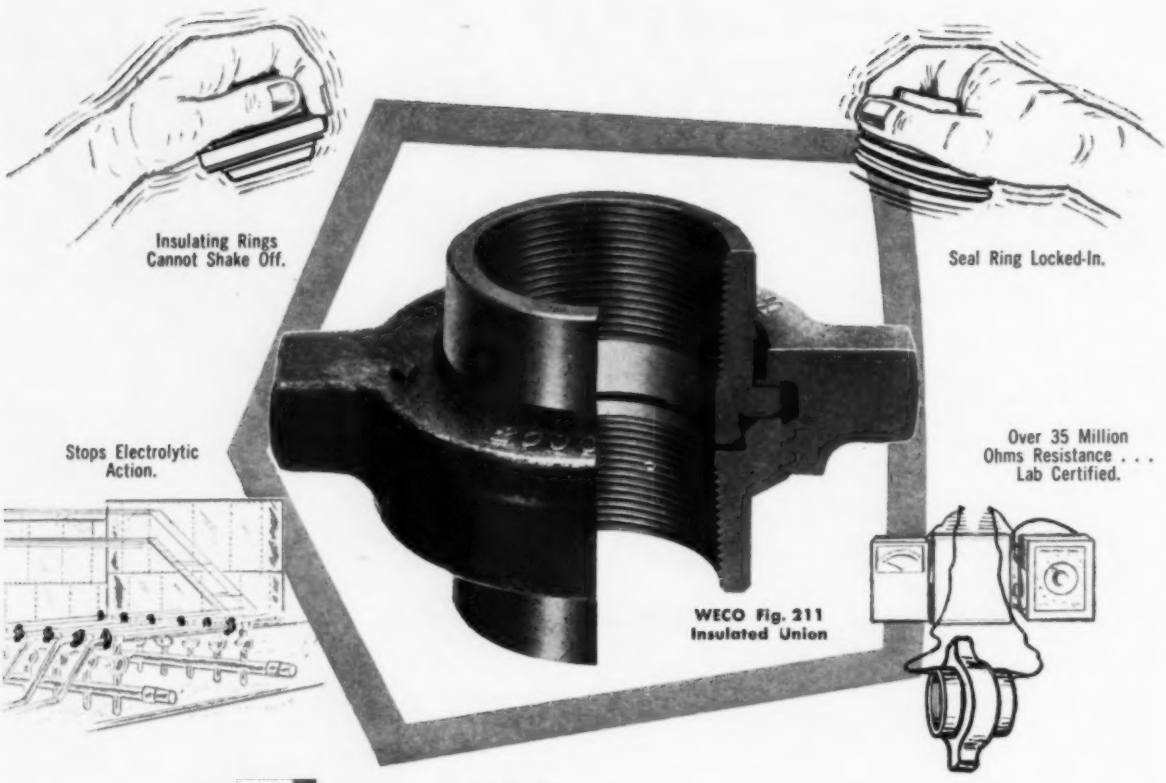
CF&I

LOOK FOR THE YELLOW TRIANGLE

PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

THE COLORADO FUEL AND IRON CORPORATION—Albuquerque • Amarillo • Billings • Boise • Butte • Denver • El Paso Farmington (N. M.) • Fort Worth • Houston • Kansas City • Lincoln (Neb.) • Odessa (Tex.) • Oklahoma City • Phoenix • Pueblo Salt Lake City • Tulsa • Wichita • **PACIFIC COAST DIVISION**—Los Angeles • Oakland • Portland • San Francisco • San Leandro Seattle • Spokane • **WICKWIRE SPENCER STEEL DIVISION**—Boston • Buffalo • Chattanooga • Chicago • Detroit • Emlenton (Pa.) New Orleans • New York • Philadelphia

5736



NEW! WECO INSULATED UNION WITH LOCKED-IN INSULATION

Proved practical and reliable in one year's field testing, WECO Insulated Unions have been laboratory certified to provide more than 35 million ohms resistance across the union to stop electrolytic action on fittings and pipes. Insulating rings are locked-in to stay-put during handling and make-up so your crew loses no time picking up lost insulation material or holding it in place.

The special laminated insulating rings and tough rubber seals operate at temperatures up to 350° F.

And these WECO Insulated Unions can take it, the same as any WECO Union. Even after hundreds of make-up and break-out cycles they still seal for long economical service.

Insist on WECO Insulated Unions . . . available in sizes 1" through 4", for pressures up to 2000 psi . . . stocked by supply stores everywhere.

U-1-88

WECO®

WELL EQUIPMENT MFG. CORP.
HOUSTON, TEXAS

Division of CHIKSAN COMPANY *a subsidiary of*
FOOD MACHINERY AND CHEMICAL CORPORATION

HOMCO HOUSTON OIL FIELD MATERIAL COMPANY Inc.

directional drilling is the answer

25 Years Experience

Sidetracking
Straightening
Surveying

This can be done...

...so why this?

HOMCO Directional Drilling is the answer to offshore - tidelands operations. Directional Drilling of multiple wells from one platform or barge location is just one of many HOMCO Directional Drilling services. As many as nineteen directional holes have been drilled without moving the barge. The holes being started from six-points on the barge, the derrick and rig being moved from one location to another on the barge floor. Operations such as this have resulted in the savings of thousands of dollars, since the cost of moving the rig is small in comparison to the cost of floating and sinking the barge for each new location. HOMCO's combination for the best in modern directional drilling tools and methods in the hands of HOMCO's highly trained and experienced directional drilling engineers, is the answer to your directional drilling problems.

THE WORLD'S LARGEST INDEPENDENT OILFIELD SUPPLY AND SERVICE ORGANIZATION

DIRECTIONAL DRILLING
FISHING AND CUTTING
OILFIELD SUPPLIES
ELECTRICAL WELL SERVICE

HOMCO HOUSTON OIL FIELD MATERIAL COMPANY Inc.

HOUSTON, TEXAS

RESEARCH • ENGINEERING • DEVELOPING • MANUFACTURING

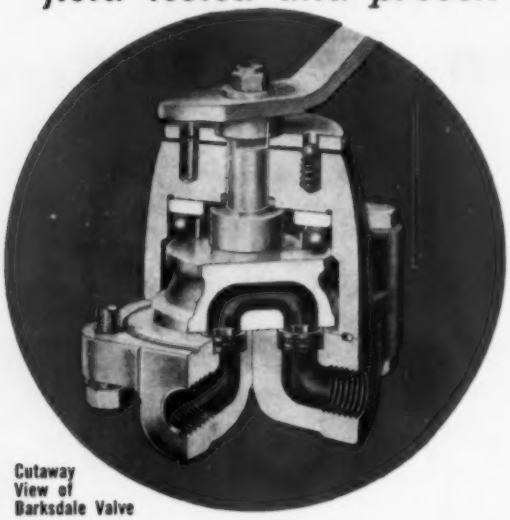
HOMCO Export Offices

Houston Oil Field Material Company, Inc.
509 Madison Avenue
New York City, New York

HOMCO de Mexico, S. A.
Edificio Reforma-Versalles
Paseo de la Reforma #76, desp. 503
Mexico 6, D. F.

controlled by BARKSDALE "*SHEAR-SEAL*" VALVES

field tested and proven for maximum dependability!

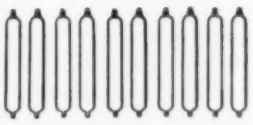


Cutaway View of Barksdale Valve

- **No freeze-ups** . . . BARKSDALE VALVES are not critical to pipe scale or dirt. Foreign matter is wiped away by square corner of "Shear-Seal" . . . flushed out through return port.
- **Low handle load** . . . pressure balanced and self-aligning "Shear-Seals" are always free to move even after long inoperative periods.
- **Leakproof** . . . positive closure provided by BARKSDALE VALVES eliminates power loss due to internal leakage.
- **Trouble-free** . . . "Shear-Seals" are self-lapping and wear compensating . . . BARKSDALE VALVES actually improve with use . . . require exceptionally low maintenance.

• Patented

only KOOMEY closing units offer all these safety features



3 to 10 accumulators

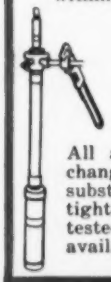
Individual ten-gallon accumulator bottles (3000 psi working pressure) in manifold to form a compact system that will operate even if several of the nitrogen filled bags within the bottles should fail.

2 to 5 motors

Heavy duty units which require no oiling or maintenance . . . completely separated from pumps for ease of repair and to eliminate danger of material being pumped seeping into motor.

2 to 5 pumps

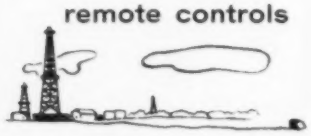
Each double action pump assembly is operated by a separate motor and each motor and pump assembly is capable of closing the rams of a blowout preventer independently.



quick pump change

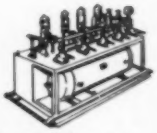
All a roughneck needs to do to change pumps is break one union, substitute an exchange pump and tighten the union. Thoroughly tested, guaranteed pumps are available for exchange.

remote controls



Added safety is provided by dual controls—one set on the rig floor and the other at a safe distance from the rig.

wide range of models



Specifically designed models are available to meet the requirements of each type of blowout preventer, and components may be assembled into custom-made units to solve specific problems.

CONTACT THE AGENT NEAREST YOUR CITY FOR

Doug Meador
New Orleans, Louisiana
Phone VA 8096 or AU 2611
Lafayette, Louisiana
Phone CE 5-7484

Roger Smith
Townsend Hotel
Casper, Wyoming
Phone 5713

Jack Parks
Tillery & Parks Co.
912 North Grant
Odessa, Texas

W. L. (Dave) Davies
Tillery & Parks Co.
912 North Grant
Odessa, Texas

Aubrey Handley
Acme Oil Tool Co.
1037 S. E. 29th St.
Oklahoma City, Oklahoma

L. M. (Stub) Snedeker
Acme Oil Tool Co.
1037 S. E. 29th St.
Oklahoma City, Oklahoma

New York City, New York

Paseo de la Reforma #76, desp. 503
Mexico 6, D. F.

most powerful closing unit ever built!

the new combination air and electric

KOOMEY CLOSING UNIT

STEWART & STEVENSON DISTRIBUTING CO.

STEWART & STEVENSON DISTRIBUTING CO.
OILFIELD DIVISION
1719 Preston Avenue • P. O. Box 1637
Houston, Texas • Phone CA 5-5341

Designed to handle any well—anywhere—this new KOOMEY Closing Unit will charge a 100-gallon accumulator system to 1500 psi in just 2.17 minutes . . . an 80-gallon system to 3000 psi in 3.4 minutes. Stall pressure is 5000 psi using 100 psi air input pressure—10,000 psi using 200 psi air input pressure. One remote control is included and, like all KOOMEY Closing Units, it features multiple pumps and multiple accumulators for maximum safety.

COMPLETE INFORMATION ON KOOMEY CLOSING UNITS

Don Burner
Acme Metex Tool Co.
418 S. Grimes St.
Hobbs, New Mexico
Phone EXpress 3-2171

Harold Sadberry
Great Bend
Fishing Tool Co., Inc.
P. O. Box 617
Great Bend, Kansas
Phone 7819

Frank Broadway
4821 Edith
Corpus Christi, Texas
Phone UL 2-0794

Ed Carney
EXPORT
Stewart & Stevenson
Distributing Co.
74 Trinity Place
New York 6, New York

Calvin Hohle

Paul Koomey

Stewart & Stevenson
Distributing Co.
(Oil Field Division)
1719 Preston Ave., P. O. Box 1637
Houston, Texas, Phone CA 5-5341

Diamond Roller Chains in their third year of service on this Air Drilling Compressor Compound Unit

The original Diamond Oil Country Roller Chains are still driving this Gardner-Denver Compressor unit now in its third year of "continuous" duty in air drilling.

Alamo Machine and Engine Works selected Diamond for driving the three six cylinder compressors in this and similar units because of their uniform highest quality, dependability, and endurance in rugged service.

Service like this makes Diamond Oil Country Roller Chain first choice of leading manufacturers and contractors. If you haven't tried Diamond, now is the time to discover how it can reduce down-time and maintenance costs for you.

DIAMOND CHAIN COMPANY, Inc.

A Subsidiary of American Steel Foundries

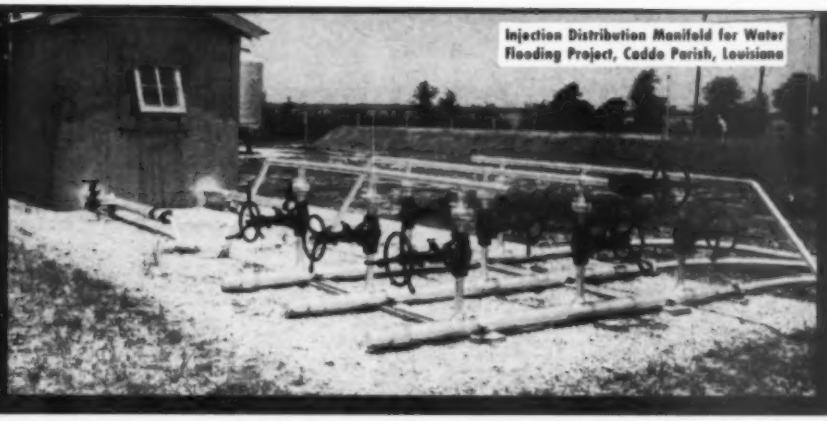
Dept. 441, 402 Kentucky Avenue, Indianapolis 7, Ind.

Tulsa Office: 2238 Terwilleger Blvd.

Offices and Distributors in All Principal Cities. Please refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER

DIAMOND ROLLER CHAINS

Injection Well for Water Flooding Project, Caddo Parish, Louisiana



Injection Distribution Manifold for Water Flooding Project, Caddo Parish, Louisiana

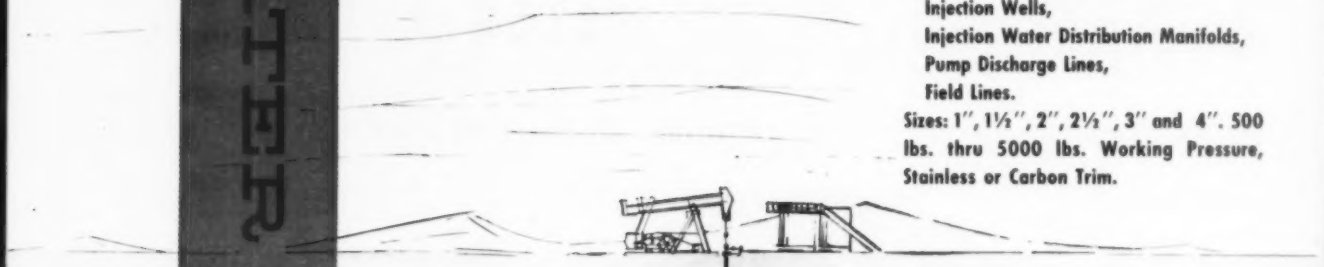
WATER FLOODING WITH ORBIT FORGED STEEL VALVES

FOR LOW, MEDIUM OR HIGH PRESSURE SYSTEMS BRINE* OR FRESH WATER

ORBIT FORGED STEEL VALVES ARE WIDELY USED IN WATER FLOODING SYSTEMS— for Services such as:

Injection Wells,
Injection Water Distribution Manifolds,
Pump Discharge Lines,
Field Lines.

Sizes: 1", 1½", 2", 2½", 3" and 4". 500 lbs. thru 5000 lbs. Working Pressure, Stainless or Carbon Trim.



REASONS WHY YOU SHOULD USE ORBITS IN WATER FLOODING SYSTEMS:

1. Non-lubricated friction-free shut-off.
2. Trouble-free—Orbit valves will continue to operate easily even under the severest corrosive conditions encountered in water flooding service. Corrosion does not interfere with the opening or closing operation of Orbit valves.
3. Availability—Stocked by your local supply store.
4. Full round straight thru unrestricted opening.
5. Full range of sizes.
6. Eliminates contamination from valve lubricants.

*For Brine Services we recommend stainless trimmed Orbit valves.

ORBIT VALVE COMPANY
Tulsa, Oklahoma, Box 699, LUther 4-4761, TWX TU 925

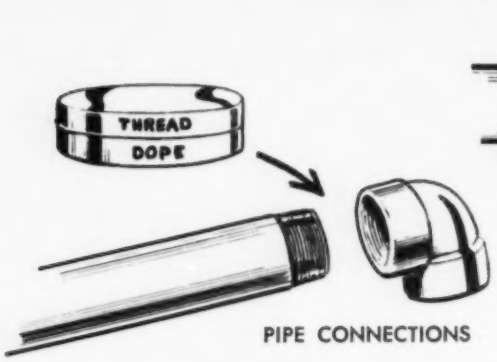
WAREHOUSES: HOUSTON, TEXAS, 407 Velasco, CApitol 8-6623, TWX HO 115; ODESSA, TEXAS, 402 West County Road, FEderal 7-2263, TWX ODESSA TEX 8041; EDMONTON, ALBERTA, CANADA, 7119-104th Street, Phone 391-283

WEST COAST REPRESENTATIVE: Fred P. Koenig Company, Long Beach, Calif., 3815 Atlantic Avenue, GArfield 4-3834

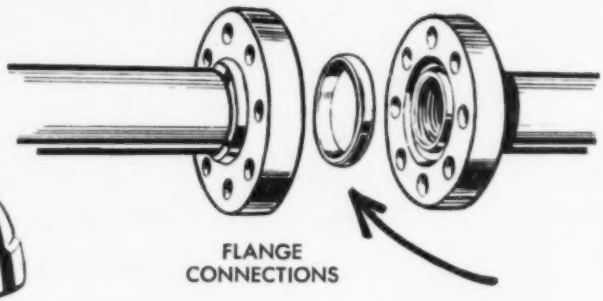
CANADIAN REPRESENTATIVE: T. R. Pickford & Company, Ltd., Calgary, Alberta, 536 8th Avenue West, Phone 2-7371

EXPORT REPRESENTATIVE: New York 36, N. Y., 500 Fifth Ave., BRyant 9-2236

WHY GASKET IMMOBILE CONNECTIONS . . .

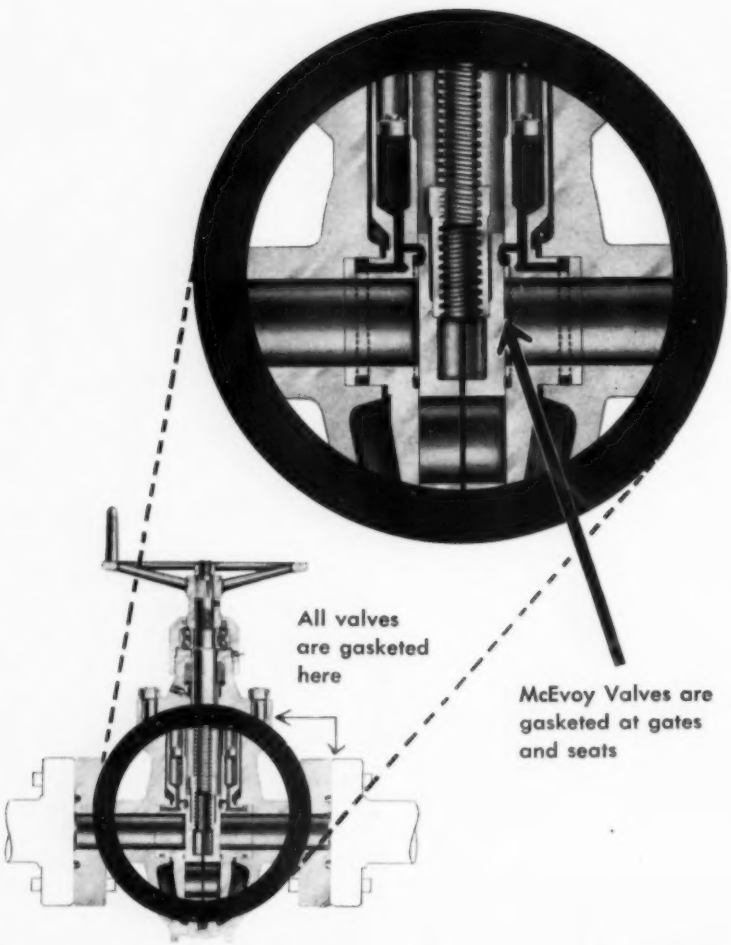


PIPE CONNECTIONS



FLANGE CONNECTIONS

BUT NEGLECT VALVE GATES AND SEATS?



McEvoy Valves are Automatically Gasketed at the Gates & Seats

It is common practice to gasket all screwed or flanged valve connections to insure tightness. But tightness is even more important between valve gates and seats where movement occurs. Leakage not evident from the outside, *does exist* around movable parts in some valves. McEvoy Valves *eliminate* internal leakage.

The exclusive patented McEvoy self-sealing system automatically gaskets between gates and seats after every operation . . . stops leaks the instant they start. Only McEvoy Valves provide this outstanding assurance of tightness and economy.

Get the full story. Write today for full information on McEvoy Self-Sealing Valves.

McEvoy COMPANY

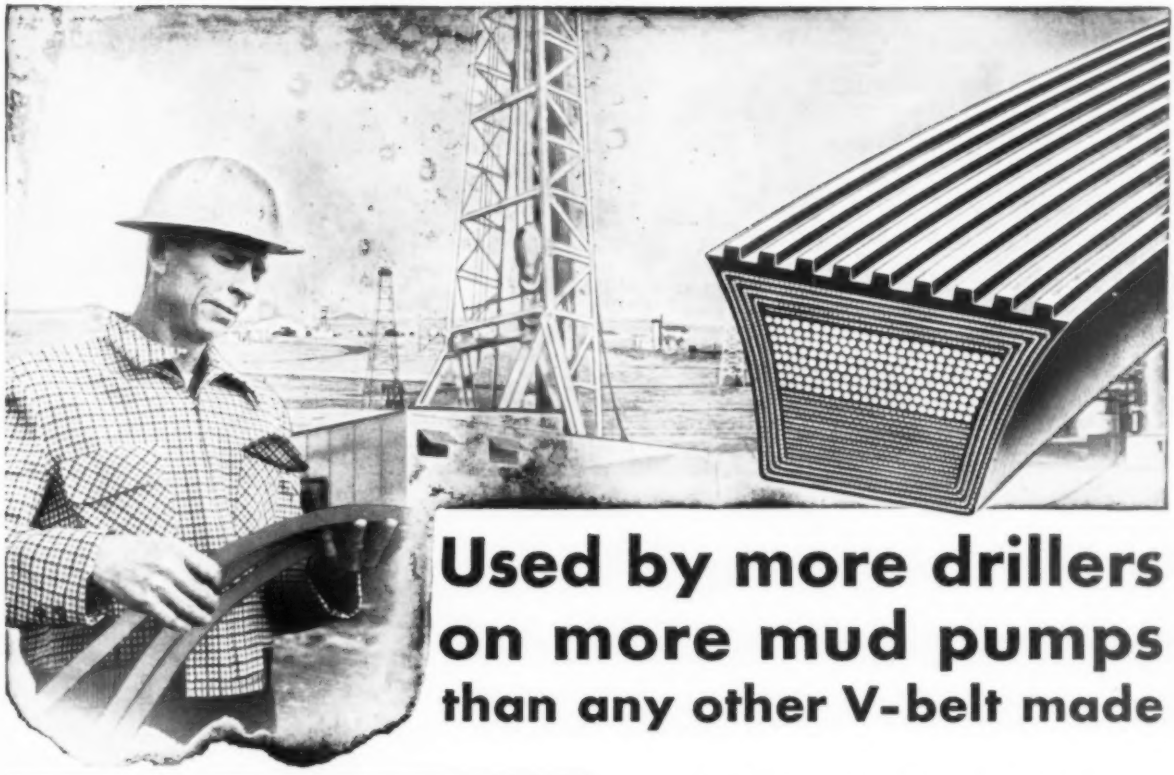
OIL WELL EQUIPMENT

Texas and Milby Streets • P. O. Box 3127
Houston 1, Texas

CANADIAN REPRESENTATIVE: T. R. Pickford & Company, Ltd., Calgary, Alberta, 536 8th Avenue West, Phone 2-7371

EXPORT REPRESENTATIVE: New York 36, N. Y., 500 Fifth Ave., BRyant 9-2236

*For Brine Services we recommend stainless trimmed Orbit valves.



Used by more drillers on more mud pumps than any other V-belt made

World leadership is the result of these 4 engineering developments

1. Tougher, more resilient cords are able to absorb the severe pulsations of mud pumps; easily handle peak loads.

2. True-fitting concave sidewalls (U. S. Pat. No. 1813698). As a Gates Belt bends around a sheave, the concave sides fill out . . . become straight . . . fit sheave grooves evenly. (Fig A.) This uniform groove contact insures greater pulling power, less wear, longer life.

Straight sided belts bulge at the sides when bent. Uneven contact (Fig. B) causes uneven wear; shortens belt life.

3. Stabilizing ribbed tops (U. S. Pat. No. 2548135) are exclusive with Gates. They dampen vibration, protect top of belt from damage, keep belt running smoothly over idler-equipped mud pump drives with no side whip.

4. Flex-Weave cover (U. S. Pat. No. 2519590) provides greater flexibility with far less stress on fabric. Wears longer . . . lengthens belt life . . . lowers belt costs.

The four engineering developments shown at left make Rib-Top an outstanding performer in mud pumping operations.

Yet Rib-Tops cost no more than ordinary belts of comparable ratings.

For fewer V-belt replacements and lower costs on mud pump drives, always specify Rib-Top. Both Standard and Super Rib-Top are available at your nearby oil field supply house.

The Gates Rubber Co., Denver, Colorado
World's Largest Maker of V-Belts

Put Super Rib-Top on the tougher drive jobs. With 40% greater horsepower capacity, Super Rib-Top easily handles drive overloads. Fewer belts and narrower sheaves solve space and weight problems.

Gates The Mark of *Specialized* Research

Gates Rib-Top Vulco Rope

DEVELOPED ESPECIALLY FOR MUD PUMP DRIVES

TPA 167

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

FOR FURTHER INFORMATION ON
ADVERTISED PRODUCTS, SEE READER SERVICE CARD

"For 29 years I've seen Reed constantly modernize machines and methods . . . . To keep Reed bit quality the best."

When Machine Repairman B. N. Hitt talks about Reed manufacturing methods, son Carlton Hitt listens with respect. B. N. Hitt started at Reed in 1929, and for 29 years has been in an ideal spot to observe the constant development of Reed's production facilities and processes.

Mr. Hitt recalls that when he first joined Reed every bit cutter was actually a "hand-made" job. One man put one cutter at a time through each necessary machine operation to completion—machined the blank piece of steel, milled the teeth, and then ground the bearing race.

Using these methods, Reed turned out the finest rock bits of that era. In 1929 Reed was showing the way to longer bit life and increased footage per bit with the first roller bearing (anti-friction) rock bit.

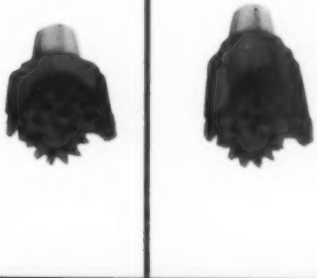
Modern plant machinery and production line techniques have long since replaced these "job shop" methods. Today, Reed Y Bit cones like those in the photograph move along production lines in quantity lots. Each step of the manufacturing process is controlled by skilled, experienced craftsmen in charge of modern, precision machines.

The Reed Y Bits produced by the facilities and methods of today are, like the "hand-made" Reed Bits of 1929, the finest of their era.

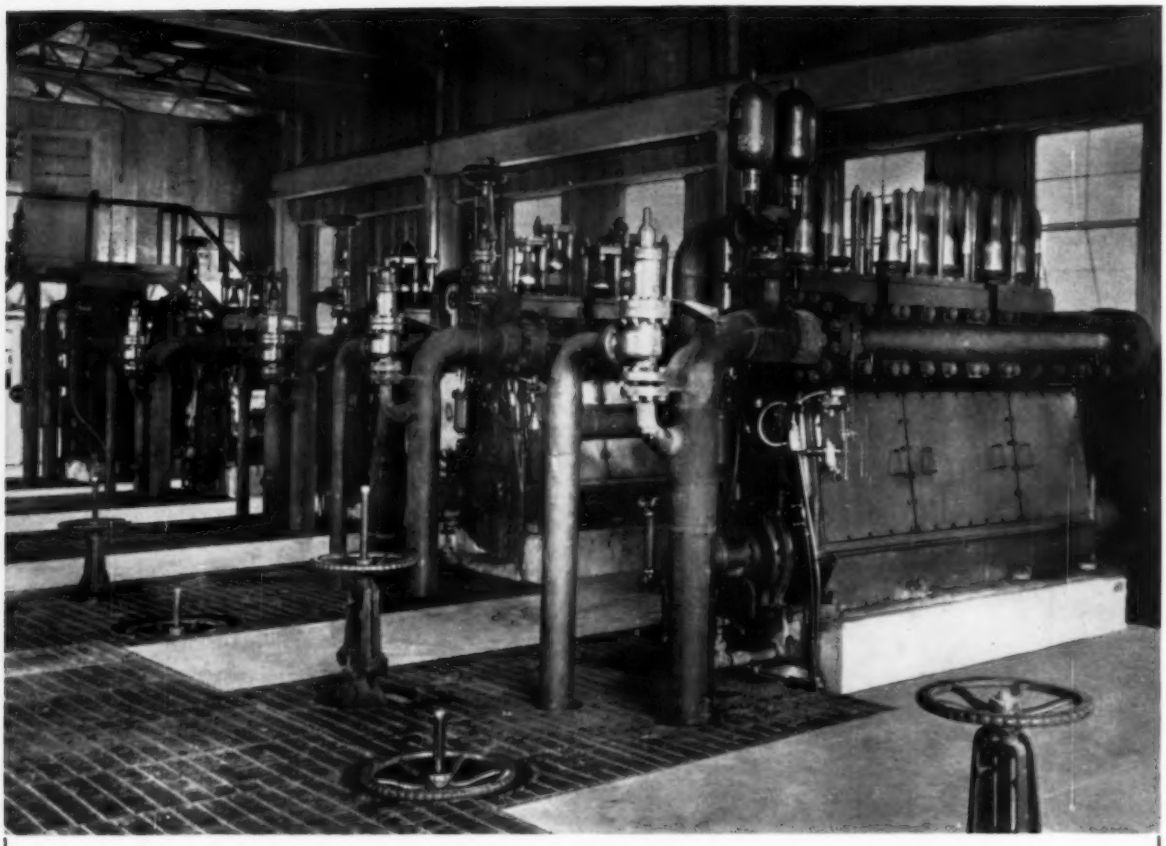
Production techniques have been modernized and product designs have changed. But you can be sure of this: The high standard of Reed quality has been, and will remain, unchanged through the years.

REED ROLLER BIT COMPANY • Houston 1, Texas

REED Y BITS



Machine Repairman B. N. Hitt, shown talking to his son, has been with Reed 29 years. His son, Carlton Hitt, has been with the company a year.



FIELD REPORT

FLOOD: Salem Unit

PUMPS: 10 Aldrich Pumps

2 Variable Stroke, 2 Triplex, 2 Quintuplex, 4 Septuplex

FLOODING STARTED: April 1953

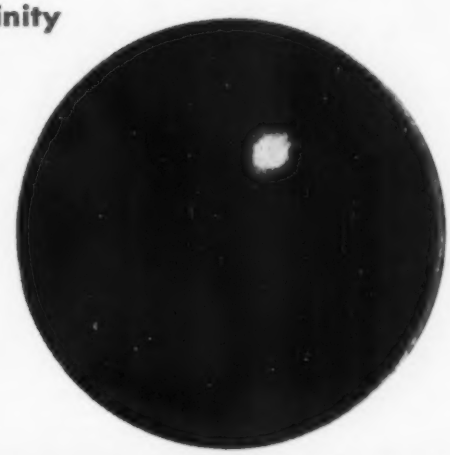
EXPERIENCE TO DATE:

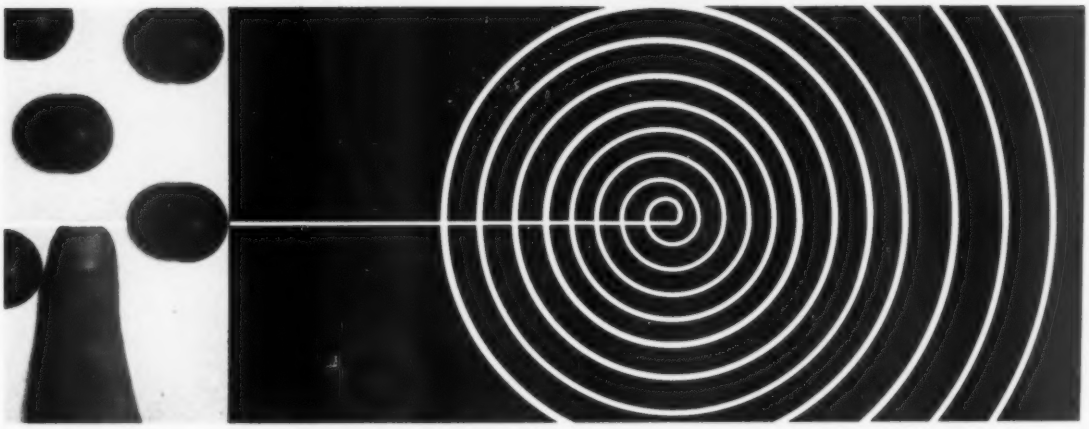
Pumps operating currently under 800 lb pressure, delivering 171,000 bbl a day. Handle mixture of fresh water and oil field brine. Routine maintenance every 4000 hours. Customer reports pump operation and Aldrich field service "satisfactory."

Field parts stock available in Carmi, Ill.; Charleston, W. Va.; Houston; Los Angeles; Odessa and Tulsa. For further information, write the Aldrich Pump Company, 26 Pine Street, Allentown, Pa.

the toughest pumping problems go to ALDRICH

engineering planned to infinity





perforation ball sealers

Continuous engineering development of all Western products and services provides the oil industry with greater effectiveness in well completion and remedial work.

Western services are engineered from the lab to the well—in a never-ending program designed to insure the most advanced well services available.

Perforation Ball Sealer Process, introduced by Western in 1956—and now an industry standard—is a part of the continuous development program. Field performance data and laboratory experiments have led to the superiority of today's Western Ball Sealer treatments.

But development does not end here. New treating techniques, new materials and tools are constantly being sought—and your future wells will benefit from this infinite engineering endeavor.

Perforation Ball Sealer Process is just a single example of Western engineering for improved well servicing—and you will find the same engineering advantages in all Western services.

Gammatron Logging
Perforating
Fracturing
Acidizing
Selective Water-Seal Service

WESTERN ENGINEERING MAKES THE DIFFERENCE!

THE WESTERN COMPANY

general offices: Midland, Texas

TEXAS:
Andrews
Borger
Lubbock
Midland
Odessa
Rankin
Seagraves
Snyder

OKLAHOMA:
Healdton
Lindsay
Oklahoma City

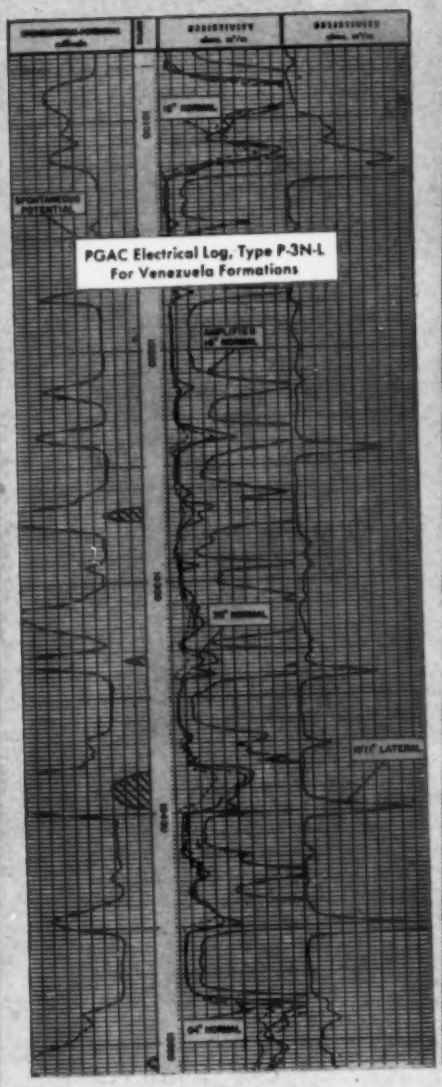
KANSAS:
Liberal
Ulysses

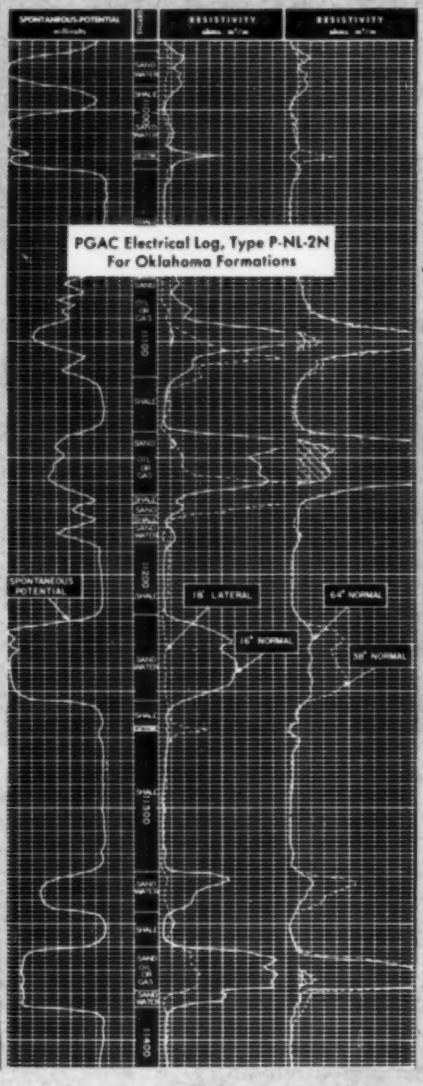
NEW MEXICO
Hobbs
Farmington

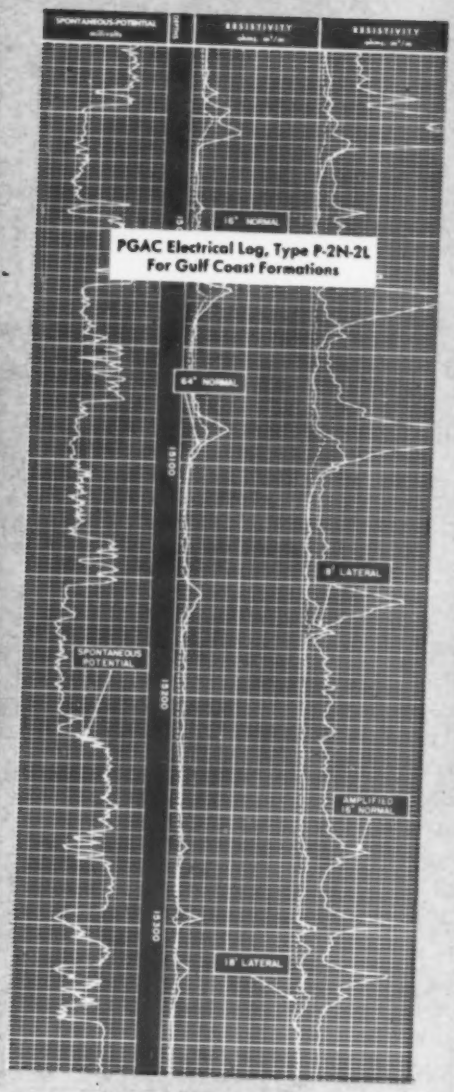
COLORADO.
Cortez

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

For FLEXIBILITY in Electrical Logs—
Your Best Bet Is PGAC







4 RESISTIVITY CURVES and 1 S.P. = 5 Curves for more data

PLUS 1 Amplified Normal Curve placed where you want it—and all recorded simultaneously

CODE TO LOG TYPES:
P—Spontaneous Potential
N—Normal Curve
L—Lateral Curve

....for ELECTRICAL LOGS

PLAY IT SAFE--*always call* PGAC

PGAC-583

PERFORATING GUNS ATLAS CORPORATION

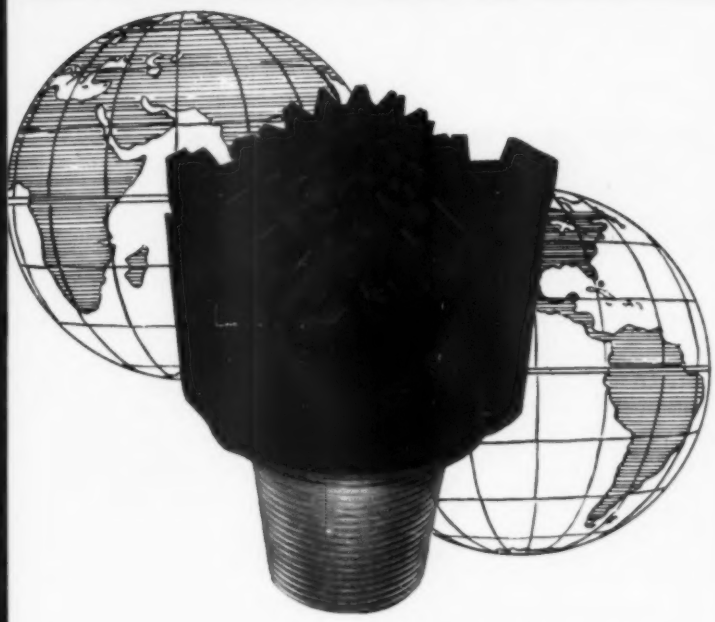
Houston, Texas Telephone REpublic 4-1651
General Offices and Main Plant: 7730 Scott Street — Sales Office: Melrose Building

PGAC OIL FIELD SERVICES

CALL FOR PROMPT SERVICE — ALWAYS READY TO SERVE YOU

TEXAS: Alice — Beaumont — Bridgeport — Colorado City — Corpus Christi — Crane — Dallas — Fort Worth — Gainesville — Houston — Longview — Midland — Odessa — Pampa — Victoria — Wichita Falls. ARKANSAS: Magnolia.
OKLAHOMA: Oklahoma City — Pauls Valley — Perry — Tulsa. NEW MEXICO: Farmington — Hobbs. MISSISSIPPI: Laurel.
LOUISIANA: Buras — Houma — Lafayette — Lake Charles — Shreveport. KANSAS: Great Bend — Liberal.

AFFILIATE COMPANIES: CANADA — Perforating Guns of Canada, Ltd.; Edmonton, Alberta
GERMANY — Atlas Deutsch- Amerikanische Olfelddienst G. m. b. H.; Kiel VENEZUELA — Servicios Tecnicos Atlas, C.A., Caracas



announcing: NEW WORLDWIDE AVAILABILITY

Today . . . every drilling area in the free world enjoys prompt delivery of Security rock bits and other drilling tools.

District offices, with field engineers to administer specific area requirements, serve the world's oil capitols. Security manufacturing plants produce rock bits to *identical* standards in both Western and Eastern Hemispheres. Security continues its pioneering role in rigside service — and its pacemaking in rock bit advancement.

Small wonder that Security's sales curve climbs up and up!

In your drilling, experience that plus ≠ bit of Security, the product of vanguard engineering . . . sterling quality . . . worldwide uniformity . . . and matchless rigside service.

CONSULT YOUR . . .

1957-58 COMPOSITE CATALOG

Security

ENGINEERING DIVISION

DALLAS, TEXAS • WHITTIER, CALIFORNIA

EXPORT OFFICE P. O. BOX 13647, DALLAS, TEXAS

Security

NOW 2nd IN SALES

GENERAL OFFICES and MAIN PLANT

DALLAS, TEXAS

WEST COAST PLANT

WHITTIER, CALIFORNIA

SECURITY ROCK BITS, LTD.

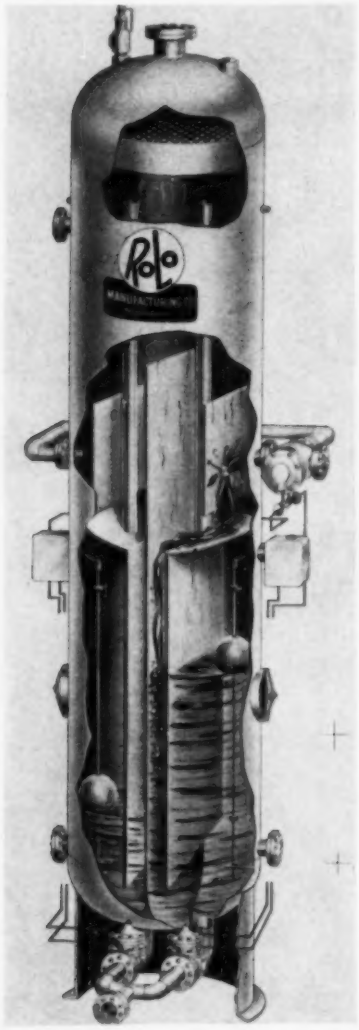
MANCHESTER, ENGLAND

It's New

Drilling – Producing Equipment

New High-Volume Separator Features Dual Dump Chambers

A new concept in separating and metering oilwell production — a unit which can handle up to 50,000 bbl a day — has been developed by the Rolo Manufacturing Company.



Known as the HI-CAP metering separator, it incorporates a new design for an oil metering unit which handles high individual flows or high combined flow rates. The unit handles low-gravity, viscous crudes easily, as well as high gas entrainment crudes. Viscosities of 100,000 SSU and higher can be handled with the HI-CAP. The problem of high variable gas entrainment is met through metering by weight, as opposed to volumetric metering.

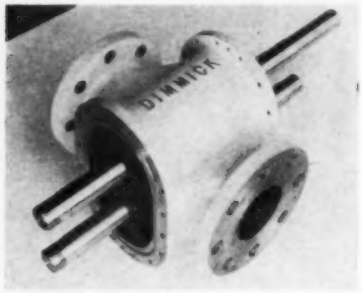
The separator has parallel dump-type meter chambers which fill as fast as the incoming flow rate. There is no gravity flow through restrictive lines and valves. There is no time-consuming accumulation of oil while a meter is dumping, because the parallel meter chambers continuously meter all oil produced. Precision-engineered instrument systems (electric or pneumatic) are available on all units to meter oil by weight (in addition to volume). Thus, foamy or other high gas content oils are accurately metered by the simple attachment of these instruments.

HI-CAP metering separators are available in diameters from 36 through 60-in. Larger diameters are available on special order. *Rolo Manufacturing Company.*

Circle number (1) on reply card.

Positive Displacement Rotary Pump

A new Dimmick 3-in. positive displacement rotary pump has gone into full-scale production. Ports of the pump are so designed that the liquid is spread across the full width of the impellers and the liquid velocity is coordinated with the speed of the pumping impellers.



The pump is self-priming, has positive suction and is completely reversible. Relatively light (147 lb), it can pump all liquids from water to high viscosity fluids and abrasives including 78 percent solid materials. Impellers are Neoprene, Hy-Car or natural gum rubber. Approximately ½ gal liquid can be pumped per revolution. *Dimmick Pumps, Inc.*

Circle number (2) on reply card.

Taper Plugs for Casting Repairs

A new type of taper plug has been developed by United States Casting Repair Corporation. Called "Sealace," these plugs are ideally suited for pinning or lacing cracked engine blocks, heads, valveports, cylinders or any other industrial casting. Their slotted hex-head permits tightening with either a wrench or a screwdriver.

The plugs are manufactured of a steel alloy guaranteed to withstand extremes in temperature and the pressures of expansion and contraction. Since the steel in Sealace expands at a slightly greater rate than cast iron, the plug provides a tighter fit than cast iron plugs. *United States Casting Repair Corporation.*

Circle number (3) on reply card.

Nylon Tube Trunk

A nylon tube trunk which can be made in any specified length up to 1000 ft has been developed by M & Q Plastic Products. The flexible trunk consists of a group of color-coded nylon tubes clustered within a tightly braided stainless steel sheath.

The new assembly features light weight and resistance to most corrosive conditions as well as the ability to contain high pressures for prolonged intervals at temperatures up to 250 F. The trunk is also said to conserve space and to embody noteworthy durability, ease of installation and lower cost. *M & Q Plastic Products.*

Circle number (4) on reply card.

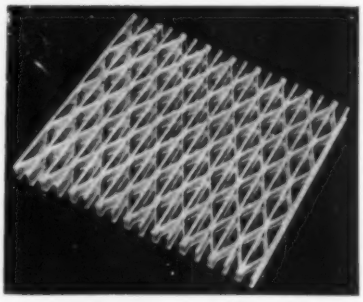
High Power UHF Radio Transmitter

General Electric is producing a new high power UHF base station radio transmitter designed to give dispatchers of mobile communication systems more ability to reach vehicles traveling in outlying areas. Engineered to deliver up to 250 w, the unit may be licensed for operation in the 450-460 mc band.

The transmitter increases power output up to 12 db and enables dispatchers to talk up to 50 percent farther. In terms of square miles a 12 db increase in power can more than double the area of coverage. *General Electric Company.*

Circle number (5) on reply card.

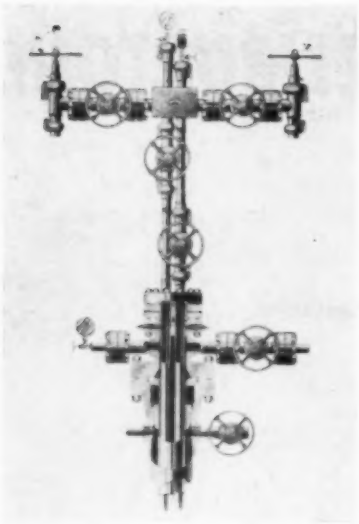
Aluminum Grating



Kerrigan Iron Works is beginning production of a new aluminum grating which contains neither bolts, screws, rivets nor welding. The grating consists of bearing bars that interlock with crimped bars, thereby eliminating conventional joining methods. The grating is roll-locked into a solid 1-piece, rattle-proof unit and features the corrosion resistance and spark-proof properties of aluminum. *Kerrigan Iron Works, Inc.*

Circle number (6) on reply card.

Wellhead with Unibolt Connections



The first 2-string Christmas tree to use Unibolt connections throughout the assembly has been announced by Rector. There are no threaded connections anywhere in the assembly. It gives the operator the advantage of a dual string with 2 separate verticals having metal-to-metal seals between each connection. Unibolt connections eliminate the need for the master valve. Trees can be built with either Unibolt tees or block tees. *Rector Well Equipment Company.*

Circle number (7) on reply card.

Small Rotary Swivel

The National J-13 rotary swivel, newest and smallest made by National Supply, has been announced. The swivel is intended for use at drilling depths of 1000 to 3000 ft. It was designed for versatility and top performance in exploratory, slim hole and shallow drilling, or on workover jobs. The comparative dead-load rating of the swivel is 60 tons. Its overall length is 4 ft and its net weight is 535 lb. *The National Supply Company.*

Circle number (8) on reply card.

Grooving Lightweight Pipe

Two new compact, portable tools that quickly roll grooves into lightweight pipe and tubing without removing any metal have been added to the line of pipe groovers developed by Victaulic. These tools are readily adjustable from 1¼ through 12-in. diameters. The tools make it easy to groove pipe ends for leak-tight jointing of water, oil, air or other lines with "Vic-Easy" snap-joint couplings. Aluminum pipe with wall thicknesses up to 0.200 in. and steel pipe with wall thicknesses up to 0.188 in. can be handled with these tools. *Victaulic Company of America.*

Circle number (9) on reply card.

Strain Gage Load Cells

A new series of precision strain gage load cells, for electrical measurement of weight of product in batching and storage tanks, provides up to 250 percent greater output with consequent reduction of interference from stray signals.

The compression cells, in small, hermetically sealed housings, are designed in 9 capacities covering the range from 500 to 200,000 lb. Cell construction permits 225 percent overload without affecting calibration; improved temperature transient characteristics and accuracy of final calibration of all cells are accomplished by manufacturer's dead-weight testing facilities. *Cox and Stevens Electronic Scales Division, Revere Corporation of America.*

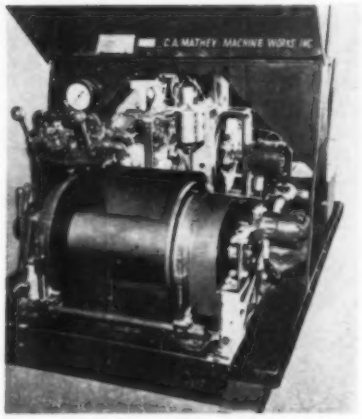
Circle number (10) on reply card.

Double-Seal Drain Valves

A line of double-seal drain valves which eliminate the need for draining a tank or feed line to correct a valve leak has been developed by Clary Dynamics Division of Clary Corporation. The line of double poppet valves has a number of applications where container or line drainage is a cost factor. The valves have a secondary poppet which automatically seals the opening when the primary poppet is removed to repair a leak, thus holding the fluid in the line or tank. *Clary Dynamics.*

Circle number (11) on reply card.

Portable Wireline Reel



A wireline reel specifically for offshore use has been designed by C. A. Mathey Machine Works. The reel has a spool capacity of 21,000 ft of 0.082 wire line and a twin brake system for cooler braking characteristics. Power source for the fluid drive system is optional. A safety valve is provided to prevent wireline breakage and a metering valve governs speeds of reel rotation. Skid mounting and lifting eyes assure easy handling. *C. A. Mathey Machine Works Company.*

Circle number (12) on reply card.

Color-Coded Plastic Shim Stock

A new line of plastic gasket and shim stock with a double identification feature has been announced by Chicago-Wilcox. Known as Wil-Pak, the stock is furnished in 6 basic gages with each thickness identified by distinctive color and also by the gage number printed in an easy-to-read over-all pattern.

Features claimed for the plastic sheet include: Impervious to oil and water, dimensionally stable, does not lose strength or form in service, uniform in gage, and a decomposition point in excess of 400 F. *Chicago-Wilcox Manufacturing Company.*

Circle number (13) on reply card.

Explosion-Proof Motors

A new line of totally-enclosed explosion-proof motors announced by Fairbank, Morse is designed to eliminate fires or explosions when motors must be operated in combustible or explosive atmospheres. Offered in both fan-cooled and non-ventilated models, these motors are manufactured in accordance with NEMA standards and bear the Underwriters Laboratories Approval labels for use under several hazardous conditions. Fan-cooled motors are manufactured in ratings of 1½ to 30 hp, and the non-ventilated motors are available in 1½-hp ratings and lower. *Fairbanks, Morse and Company.*

Circle number (14) on reply card.

Concrete Adhesive

Carboline Company has announced the development of a new modified epoxy adhesive, for use in bonding new concrete to old concrete. This material solves many difficult concrete patching jobs and assures tight bond of the new concrete to the old concrete. Entire floor areas can be resurfaced or the adhesive can be used to repair broken corners on concrete bases, curbings, islands, etc. *Carboline Company.*

Circle number (15) on reply card.

Teflon-Lined Pipe Fittings

John L. Dore Company has introduced a line of Teflon-lined pipe, ells, and tees, available in 1 through 6-in. ID sizes with flanged end connections. The pipe is offered in 10-ft lengths.

The Teflon lining is extended over the entire raised face of the flanges to make flat, smooth mating surfaces for leakproof connections, eliminating any additional gasket flange. Lining is solid and weldless. *John L. Dore Company.*

Circle number (16) on reply card.

Temperature Control Unit

A new mercury-actuated indicating temperature control introduced by The Partlow Corporation features a novel dual mounting design and greatly improved readability. Said to be accurate to within ½ percent of scale range, the controller will sense, indicate and control processes within ranges of −30 to 1100 F.

Readability features include increased dial area, special magnifying setting pointer equipped with 2 hairlines for parallax sighting, plus dial colors designed for greatest possible contrast. Instrument design permits the case to be either flush or wall mounted completely from the front of the panel. *The Partlow Corporation.*

Circle number (17) on reply card.

This is no place for second-best... it's the place for **HALLIBURTON!**

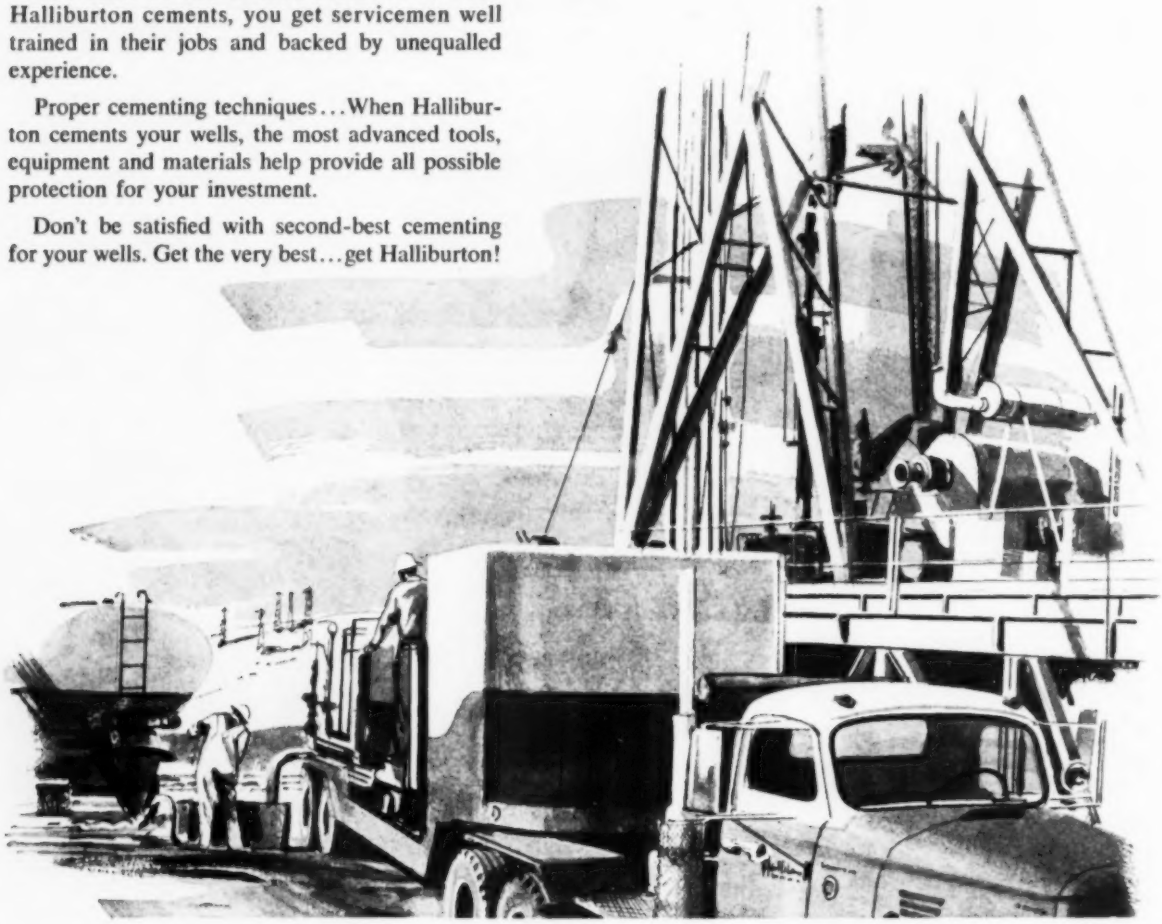
Here's an indisputable fact: Only the best oil well cementing job will give you maximum protection against the ever present hazards of corrosion, contamination and blowout.

A successful cementing operation must rely heavily on two factors:

The skill of the human element...When Halliburton cements, you get servicemen well trained in their jobs and backed by unequalled experience.

Proper cementing techniques...When Halliburton cements your wells, the most advanced tools, equipment and materials help provide all possible protection for your investment.

Don't be satisfied with second-best cementing for your wells. Get the very best...get Halliburton!



HALLIBURTON

OIL WELL CEMENTING COMPANY

DUNCAN, OKLAHOMA

TEST YOUR ADDITIVE I.Q.

Match each of these Halliburton additives to its description:

(A) **MUD-KIL**

(B) **HOWCOGEL**

(C) **DIACEL D**

(D) **HA-5**

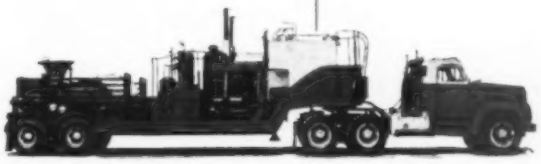
1. A high yield bentonite used in cement to reduce slurry weight and to increase slurry volume. Reduces hydro-static pressure on weak formations, helping prevent lost returns. ☐

2. An improved accelerator for oil well cementing slurries to be used for surface pipe or shallow wells. Higher compressive strengths at early ages are obtained, permitting W. O. C. times as short as four hours on surface pipe at temperatures of approximately 80° F. ☐

3. A dry, granular material that effectively neutralizes the cement-retarding properties of mud treating chemicals such as quebracho and other tannins, starch, sodium carboxymethyl cellulose and lignite. Pumping time and compressive strengths of cement are not appreciably altered. ☐

4. A light weight additive for blending with portland cement, which increases the volume of mixing water, resulting in a lighter weight slurry and a greater yield. ☐

ANSWERS:
1 – (B)
2 – (D)
3 – (A)
4 – (C)



CEMENTING SERVICES

PACE SETTER IN OIL WELL CEMENTING!

Drilling-Producing Literature

Forged Steel Unions Brochure

Clayton Mark & Company has published a new brochure entitled "What Makes a Good Union?" The 16-page, 3-color booklet contains a variety of practical tips and information and is also useful as a handy reference for training new men.

Fundamental qualities of a good union are described. Other features which are highlighted in the brochure are: Standardized design on American Association of Railroads specifications; hardness differential between seats to prevent galling and damage, and to provide for extremely tight seating; hot forged parts for heavy duty strength; and octagon wrench flats on both ends and nut. *Clayton Mark & Company.*

Circle number (18) on reply card.

Catalog of Atmospheric Coolers

Young Radiator Company has announced a new catalog on their line of horizontal core atmospheric coolers. Catalog contains important facts on design features, performance and specification data, accessory equipment, etc. Dimension data, nozzle selection diagrams and other pertinent facts contained in this catalog will be of help in determining the proper unit selection to meet requirements for cooling and temperature control of oil, water, or gases or for condensing vapors. *Young Radiator Company.*

Circle number (19) on reply card.

Temperature Measurement Catalog

Yellow Springs Instrument Company, manufacturers of thermistor-based temperature measurement and control instrumentation, has available a new short form catalog describing its products. The complete line of remote indicating thermometers, thermistor probes, and temperature controllers is described and illustrated in this 4-page brochure. *Yellow Springs Instrument Company.*

Circle number (20) on reply card.

Welded Steelcase Meter Bulletins

Three new bulletins from American Meter cover the company's lines of welded steelcase displacement meters. Bulletin 304 gives technical information on the entire line including meters with rated capacities of 75 to 300 cu ft per hr, rated with 0.64 sp gr gas at ½-in. pressure drop and 5 psi rated working pressure.

Bulletin 303 gives detailed information on the W-75 welded steelcase meter which has a rated gas capacity of 75 cu ft per hr. Bulletin 302 describes the new W-45 LPG welded meter with rated capacity of 45 cu ft per hr propane. *American Meter Company, Inc.*

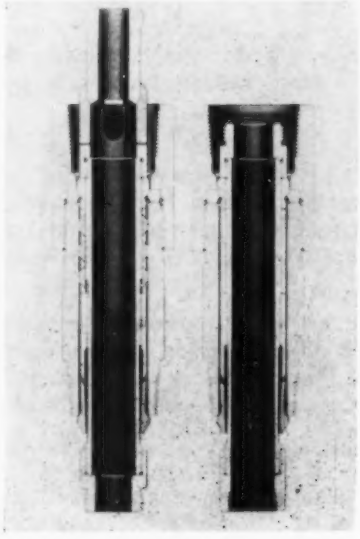
Circle number (21) on reply card.

Gas Lift Calculations and Equipment Books

The Merla Tool Corporation has published a manual entitled "Gas Lift Practices and Principles." This 128-page book is a complete guide to the design, installation, operation and maintenance of all types of gas lift production systems. Many charts, tables and examples simplify calculations in both intermitting and continuous flow installations. One section of the manual is devoted to basic engineering data used in gas lift production. *Merla Tool Corporation.*

Circle number (22) on reply card.

Permanent Completion Hold-Down Booklet



A new technical booklet from Pacific Pumps gives complete operating details and parts breakdown on the company's new permanent completion hold-down device which features maximum opening through the shoe to permit use of permanent completion through it. *Pacific Pumps, Incorporated.*

Circle number (23) on reply card.

Flexible Couplings Bulletin

An 8-page bulletin from T. B. Wood's Sons Company tells how to select new "Sure-Flex" couplings suited to more than 150 different service applications. Five tables short-cut the usual engineering calculations and give the right answer in a matter of seconds, taking into consideration the type of driver, horsepower and rpm as well as the specific application. The coupling consists of 2 flanges and a 2-piece rubber sleeve which lock together without clamps or screws. *T. B. Wood's Sons Company.*

Circle number (24) on reply card.

Steel Casting Design Fundamentals

The Steel Founders' Society of America announces the publication of a revised edition of "Fundamentals of Steel Casting Design." The 1958 edition is supplemented with data derived from recent SFSA research work. The previous edition of this booklet which has been out of print for several months has consistently been one of the most popular items in the society's literature listing. *Steel Founders, Society of America.*

Circle number (25) on reply card.

Centrifugal Pumps Flier

A new flier describes Ingersoll-Rand's centrifugal pumps designed for continuous heavy-duty operation within the medium pressure range. The flier includes cross-sectional views and a complete table of pump dimensions.

The pumps are horizontally-split, single-suction units built with 3, 4, 6 or 8 stages for capacities from 200 to 2800 gal per min. *Ingersoll-Rand Company.*

Circle number (26) on reply card.

Information on Shaft Coupling Problems

H. S. Watson Company announces 2 bulletins containing helpful design information for shaft coupling problems. Four-page Bulletin F-10 lists general conditions where shafts and couplings should be considered. Complete engineering data is contained in the 8-page Bulletin F-11. The information in this brochure is intended to reduce flexible shaft selection and installation to its simplest fundamentals. *H. S. Watson Company.*

Circle number (27) on reply card.

Heat Exchanger Bulletin

New bulletin 1.1K6, published by Ross Heat Exchanger, contains details of the recently expanded line, performance improvements and new design features of 1958 type BCF exchangers. Among features illustrated are: Baffles with special flanged lip at each tube hole and around rim; stamped steel feet movable in 3 positions around hubs for easy mounting; corrosion resistant copper alloy core assembly; hubs relieved under connections for unrestricted flow.

Specifications pages give details of the 46 sizes in 1, 2 and 4-pass designs. An additional page of information on modifications for special conditions is also included. *Ross Heat Exchanger Division of American Standard.*

Circle number (28) on reply card.

Don't Forget . . .
Order Your 1957
Editorial Index
for
All Editions of
The Petroleum Engineer
NOW!

FREE! Subscribers, send your request to: P. O. Box 1589, Dallas 21, Texas.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

the Refining Engineer

Refining
Petrochemical
Gas Processing

HARSHAW

Production-Controlled High-Quality

FLUORIDES

Boron Trifluoride
Hydrofluoric Acid

ANHYDROUS . . . AQUEOUS

The uses for Fluorides are ever increasing. Harshaw Fluoride production also has increased steadily. Shipments of cylinders and tank cars leave our plant daily. If required, you are invited to draw on the knowledge and experience of our staff of technical specialists on Fluorides.

Write for your free copy of M.C.A. Chemical Safety Data Sheet SD-25 on properties and essential information about . . .
HYDROFLUORIC ACID
Anhydrous and Aqueous

THE HARSHAW CHEMICAL CO.
1945 EAST 97th STREET • CLEVELAND 6, OHIO
Chicago • Cincinnati • Cleveland • Detroit
Hastings-On-Hudson, N.Y. • Houston
Los Angeles • Philadelphia • Pittsburgh

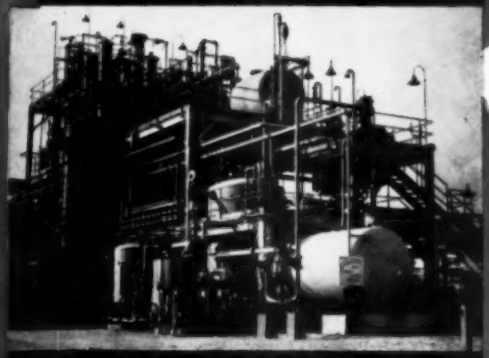
Here is a helpful list of HARSHAW production-controlled high-quality fluorides:

Ammonium Bifluoride
Ammonium Fluoborate
Antimony Trifluoride Sublimed
Barium Fluoride
Bismuth Fluoride
Boron Trifluoride
Boron Trifluoride Complexes
Chromium Fluoride
Copper Fluoborate
Fluoboric Acid
Fluorine Cells
Fluorinating Agents
Frosting Mixtures
Hydrofluoric Acid Anhydrous
Hydrofluoric Acid Aqueous
Hydrofluosilicic Acid
Lead Fluoborate
Metallic Fluoborates
Potassium Bifluoride
Potassium Chromium Fluoride
Potassium Fluoborate
Potassium Fluoride
Potassium Titanium Fluoride
Silico Fluorides
Sodium Fluoborate
Tin Fluoborate
Zinc Fluoborate
Zinc Fluoride

DROP FORGED STEEL

valves, fittings and flanges by Vogt

REFINERIES



CHEMICAL PLANTS

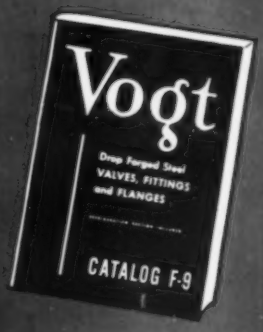
POWER PLANTS

USED and TRUSTED by the NATIONS KEY INDUSTRIES

There are good reasons behind the trust which America's key industries have placed in Vogt valves, fittings, and flanges for half a century. They know that *drop forged materials* are uniform in structure, fine grained, and free from porosity. They know, too, and appreciate the meticulous care given these products through every stage of forging and machining in Vogt's modern shops, and about the many rigid tests and inspections. And that is why these products enjoy such an impressive record of performance in withstanding the shocks and stresses imposed by high or low pressures and temperatures and in resistance to erosive and corrosive conditions.

Service is another important factor in this confidence because Vogt maintains the world's largest and most complete stock of drop forged steel valves, fittings, and flanges always ready for immediate shipment.

Write for Catalog F-9. Consult its 400 pages for the complete Vogt line of drop forged steel valves, fittings, and flanges for oil, steam, water, air, gas, and refrigeration services. Dept. 24A-FEE



OTHER VOGT PRODUCTS
Petroleum Refinery and Chemical Plant Equipment
Heat Exchangers
Ice Making and Refrigerating Equipment
Steam Generators

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati

New Projects in refining gas processing petrochemicals

Pacific Cooperatives, a newly organized company, is considering plans to build a refinery at Vancouver, Washington. Economic studies will be completed in mid-February and the decision will be announced at that time. Present plans call for a 15,000 bbl per day refinery with cat cracking, coking, alkylation, and possibly cat reforming units.

Imperial Oil Company, Ltd. is planning to spend an estimated $2.25 million on expansion of their Vancouver, British Columbia, refinery. Addition of an atmospheric furnace is expected to increase capacity by approximately 7300 bbl per day. A new depropanizer, storage tanks, a stove-oil treater, and drying facilities are to be included. Canadian Bechtel holds the prime contract.

Pure Oil Company has started construction of an addition to the Adena field gasoline plant in Colorado. One new compressor is now being installed and two more will be added within the next 60 days. This increase in horsepower is expected to increase capacity by 5 MMcf per day.

El Paso Natural Gas Company has announced plans to build a $26-million gasoline plant in the Utah portion of the Four Corners area. Plant will process 100 MMcf per day from the Aneth, White Mesa, Gothic Mesa, McIlmo Creek, Ismay, Cahone Mesa, Boundary Butte, and Ratherford fields in Utah and the Bita Creek field in Arizona. The processed gas will be sent to the San Juan River System which connects with El Paso's line to California.

Transcontinental Gas Pipe Line Corporation has awarded a contract to Fluor Corporation, Ltd., for engineering and construction of a 75 MMcf per day gas treating and dehydration plant in McMullen County, Texas. The installation, which will remove acid and water from the gas, is expected to cost in excess of $2 million.

Anderson-Prichard Oil Corporation has announced its plans to build an HF alkylation unit at the refinery at Arkansas City, Kansas. Contract has been awarded to The Refinery Engineering Company for engineering and construction of the unit. Nearly 2500 bbl per day of finished motor alkylate is expected from a mixed stream charge of propylene and butylene.

British Petroleum Company, Ltd. will begin construction of a new catalytic reformer at their Kwinana refinery in Western Australia. With a capacity of 10,000 bbl per day, the unit will cost approximately $8 million.

Sinclair Chemicals, Inc. is now building a high-purity propylene plant at Marcus Hook, Pennsylvania. The plant, said to be the first in North America built specifically for production of plastic grade propylene, should be completed in early 1958. Production from this project will supply the new polypropylene plant at Parlin, New Jersey, built by Hercules Powder Company.

Imperial Oil Company, Ltd. has announced plans for a $17-million expansion at its Calgary refinery. Contract has been awarded to Canadian Bechtel, Ltd. Construction will begin some time in the early spring with completion scheduled for the fall of 1959.

American Petrofina Company has awarded contracts for the construction of a Platformer and an alkylation unit to J. F. Pritchard & Company. The units, costing approximately $2-million, will be built at the Mt. Pleasant, Texas, refinery. An additional improvement program, which will cost $850,000, has been started to increase storage capacity, laboratory facilities, and a gasoline vapor recovery system. The Platformer will have a capacity of 3000 bbl per day charge and the HF alkylation unit will have a capacity of 1500 bbl per day. Completion is expected by October 1958.

National Cooperative Refinery Association of McPherson, Kansas, has awarded a $1.8-million contract to The Refinery Engineering Company for modernization of their McPherson refinery. Revamping of the crude, coking, and alkylation units holds the major portion of the contract.

Arkansas-Louisiana Gas Company has announced plans to build a $3-million hydrocarbon extraction plant at Magnolia, Arkansas. Proposed plant would extract 78,000 gal per day of ethane for marketing to the plastics industries. By-product LPG will be sold to wholesale dealers in the area. The new plant, to be located near two gas pipelines, is scheduled for completion in mid-1959.

British Hydrocarbon Chemicals is planning to build two plants, at an estimated cost of $22.5 million, for large scale production of synthetic phenol and high-density polyethylene. Plants, to be located at Grangemouth, Scotland, are scheduled for completion in 1959.

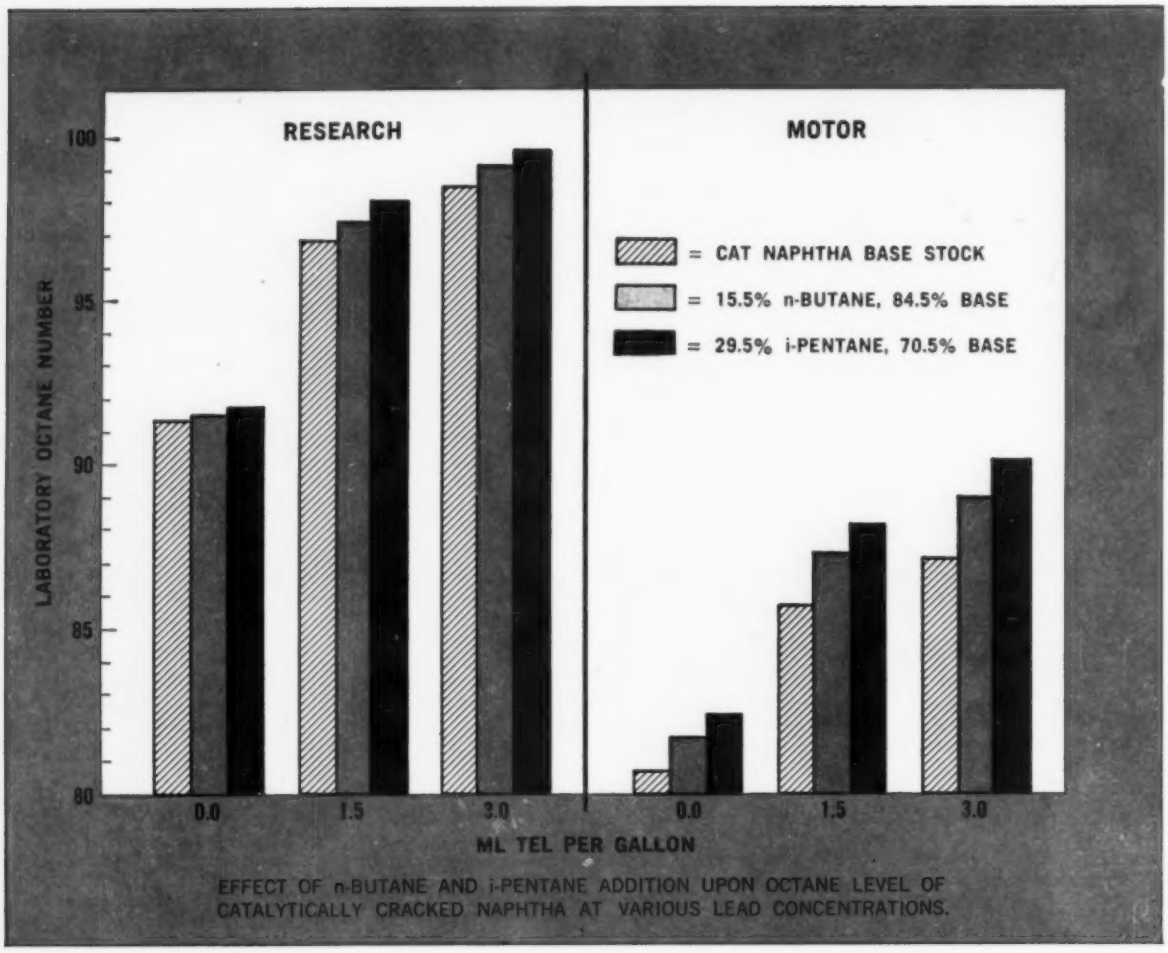
Shell Oil Company (Canada), Ltd. has announced plans to build a solvent manufacturing plant at its Shellburn refinery at North Burnaby, B. C. Fluor Corporation of Canada, Ltd. has already completed the plant design, which calls for production of solvents for various industries. Estimated cost of the project is $600,000.

Mitsui Petrochemical Industries, Ltd. has announced their plans to build an oxidized aromatics plant at Iwakuni City, Japan. Scientific Design Company developed the process that is to be used in the installation. In this design, aromatics are oxidized to make terephthalic acid, dimethyl terephthalate, and other aromatic intermediates. Scheduled to go on-stream in 1958, the plant will have a capacity of 15-million lb per year.

Tidewater Oil Company's refinery at Avon, California, will start up a new 22,500 bbl per day Houdriformer some time in March 1958. The unit, now under construction, has been designed so that existing capacity can be easily doubled. Also announced are plans to complete a coke-burning boiler next year, designed to burn some 170,000 tons per year. Coke for this unit will be supplied by the 42,000 bbl per day fluid coking unit built last year at the Avon refinery.

ANCAP, the Uruguaian government-owned oil company, is now building a refinery at Montevideo. M. W. Kellogg Company has the engineering-construction contract and the project should be completed in late 1959. The refinery's crude distillation unit will have a capacity of 28,000 bbl per day. Total cost is estimated at $12-million.

Southern Union Gas Company has announced plans to build a gasoline plant in Rio Arriba County, New Mexico. Contract has been awarded to Pona Engineers, Inc. with construction to begin in early spring. Plant will cost $813,000 and will have a rated capacity of 65 MMcf per day. Completion is set for late September 1958.



EFFECT OF n-BUTANE AND i-PENTANE ADDITION UPON OCTANE LEVEL OF CATALYTICALLY CRACKED NAPHTHA AT VARIOUS LEAD CONCENTRATIONS.

Ethyl Research Makes Precise Study of Butane and Pentane Blending

At TODAY's high-octane levels, the use of gasoline blending components in the most economic manner has taken on an ever-increasing importance to the refiner. One phase of refinery blending which has commanded continuous interest is the addition of light hydrocarbon agents to gasoline stocks for vapor pressure adjustment to yield finished motor fuels.

The best economic use of available pressurizing agents is determined to a great extent by their volatility and octane blending characteristics in various refinery stocks.

Thus, in order to establish best conditions for the pressurization of gasoline, accurate knowledge of the blending characteristics of those components employed as volatility correctors is required. Ethyl Corporation's refinery technologists can assist you in determining the most economical use of your pressurizing stocks.

For example, in a recent program, a refiner wanted to know the blending octane qualities of normal butane and isopentane when used individually as vapor pressure correctors in three base stocks—alkylate, catalytic reformate, and catalytically cracked naphtha. The objective was to find the break-even economic values of these agents as blend stocks through the use of correct blending qualities.

Blending Carried Out Under Refrigeration

Due to the critical nature of butane and pentane concentration, all blending operations were conducted in a refrigerated room (ambient air temperature, 30-35°F.) to minimize loss of agent, particularly that of n-butane. Blending was carried out on a weight basis in order to give the percentages desired.

Operations were designed to obtain representative samples for analysis and to minimize loss of material from closed containers after samples had been taken.

Exact Concentrations of Pressurizing Agents Determined by Vapor Fractionation

An accurate knowledge of the concentration of pressurizing agent in a base stock both before and after blending was needed to calculate reliable blending octane values.

Suitable techniques were developed for the exact determination of butane and pentane percentages by the use of gas chromatographic apparatus available at Ethyl's Detroit Research Laboratories.

Statistical Design Used in Obtaining Engine Ratings

Triple Research and Motor ratings were conducted on each fuel at TEL levels of 0.0, 1.5 and 3.0 ml per gallon. In order to insure completely independent determinations, each rating was conducted on coded samples which were rated in a pre-established sequence. The day-to-day variation in the CFR engine was avoided by rating all the samples on one base stock during one day's operation.

Gas chromatographic apparatus determines exact concentrations of pressurizing agents in base stock.

Engine ratings were made according to a statistical design in order to assure reproducible results. The standard deviation for the overall program was 0.20 octane number for the Research and 0.39 for the Motor method, showing good replication.

Laboratory Results Yield Octane Blending Data

Typical results of this study are shown in the bar chart on the opposite page, wherein the effects of n-butane and i-pentane additions upon octane level are shown for catalytically-cracked naphtha at various lead concentrations. From these results, the Research and Motor octane blending values have been calculated and are compared in the table (below).

At the maximum practical concentrations employed, i-pentane and n-butane possess essentially the same Research octane blending qualities at 0.0 and 1.5 ml TEL per gallon, while n-butane excels at the 3.0 ml TEL level. In every case, however, n-butane exhibits higher Motor octane qualities than does i-pentane.

Thus, while the two agents are about equal with regard to Research octane effectiveness at the percentages employed, n-butane would be preferred for this base stock when the maximum Motor octane effectiveness per quantity of agent added is an important factor.

Armed also with blending octane values derived for alkylate and catalytic reformate, the relative economic value of n-butane versus i-pentane for blending can be ascertained on the basis of octane efficiency for the refinery stocks in question.

The above program was designed primarily to show the effects of n-butane and i-pentane at concentrations approaching the Reid Vapor Pressure limits of the CFR engine. While some indication of the effects at intermediate percentages can be gained, exact blending values for a particular fuel at a given pressurizing agent concentration must be obtained by individual laboratory evaluation.

The data obtained from this type of study also permit the determination of blending Reid Vapor Pressure values for the pressurizing agents in question in various gasoline stocks.

BLENDING OCTANE VALUES OF n-BUTANE AND i-PENTANE IN CATALYTICALLY CRACKED NAPHTHA

Volume % * Agent in Base	Research O.N. @ ml TEL			Motor O.N. @ ml TEL		
	0.0	1.5	3.0	0.0	1.5	3.0
15.5% n-butane	92.1	100.3	102.2	86.8	95.3	98.4
29.5% i-pentane	92.3	100.2	101.5	86.4	93.6	96.7

*Maximum practical concentration.

How Ethyl Research is helping you

This study is another example of the professional services available to the refiner through Ethyl Corporation's Refinery Technology Program.

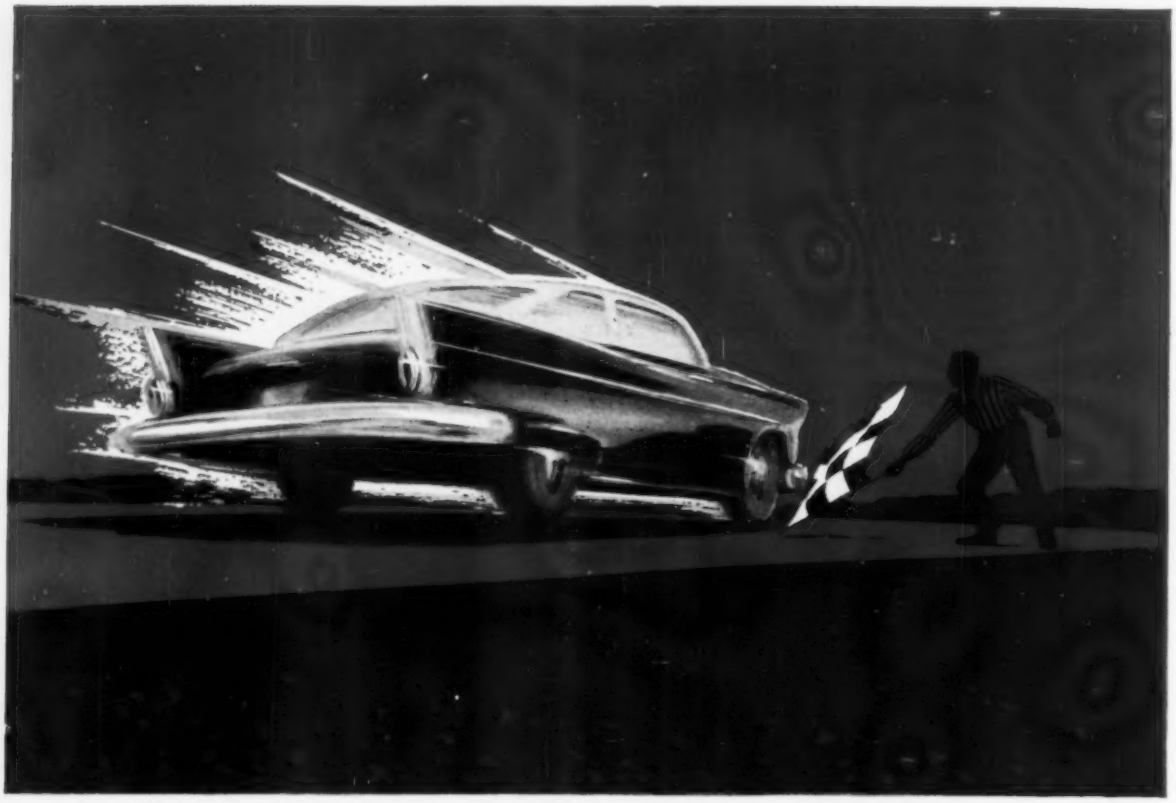
Continuous Research by Ethyl Engineers has produced significant developments and valuable information on all the phases of refining that affect octane quality.

Results of this work are helpful to refiners and can frequently be applied to your specific refining situation by our Refinery Technology staff.

For further information on Ethyl Research services, just call your Ethyl Representative. He will be glad to arrange an appointment for you.

ETHYL CORPORATION
New York 17, N. Y.

RESEARCH LABORATORIES:
1600 W. Eight Mile Road, Ferndale 20, Mich.
2600 Cajon Road, San Bernardino, Calif.



For those new, higher compression engines... a new Catforming catalyst

The trend to higher compression engines is here to stay. And wide-awake refiners have to produce fuels to suit these up-to-the-minute engines.

Atlantic is proud to offer an advanced Catforming catalyst designed to economically produce higher octane gasolines . . . *and it can be utilized in your present equipment.* For more information, write, wire or call The Atlantic Refining Company, P. O. Box 8138, Philadelphia 1, Pennsylvania.

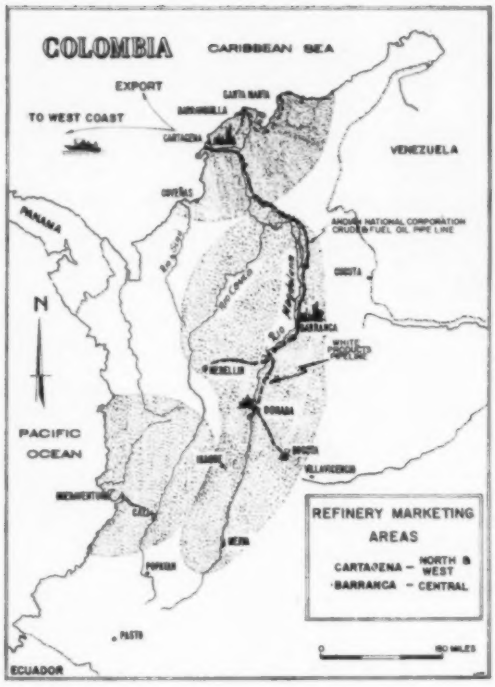
Higher gasoline octanes through Pentafining

You can convert the low-quality n-paraffins (C_6, C_6, C_7) in your gasoline pool to high octanes! Pentafining, the process developed by The Atlantic Refining Company, makes it possible. For full particulars, write today to The Atlantic Refining Company, P. O. Box 8138, Philadelphia 1, Pennsylvania.

It's the CATALYST that counts

ATLANTIC

FOR FURTHER INFORMATION ON
ADVERTISED PRODUCTS, SEE READER SERVICE CARD



CARTAGENA REFINERY: the new look in Overseas Plants

Onstream six months, Intercol's new refinery has a key role in Colombia's economy

Jon H. Baumgartner and Antonio Donado
International Petroleum (Colombia), Ltd.

THE 26,500 bbl per calendar day Cartagena refinery of International Petroleum (Colombia), Ltd., is an interesting example of modern overseas refining practice. The company operates the recently completed plant with minimum manpower and a high ratio of Colombian to North American employees. To further the assignment of Colombians to responsible jobs as soon as practicable, special emphasis has been placed on job training, both theoretical and practical. Integration of refinery forces into the community life of Cartagena has replaced the "refinery camp" concept in determining how the company should provide needed facilities outside the refinery. In brief, it's an example of the new attitude being taken toward supplying petroleum products to non-industrial areas.

History of Intercol

International Petroleum (Colombia), Ltd., or Intercol, is wholly owned subsidiary of International Petroleum Company, Ltd., a Canadian company with executive offices in Coral Gables, Florida. Intpetco was originally incorporated in 1914. Standard Oil Company (New Jersey) holds 83 percent interest of the firm's common stock. Through its subsidiaries, Intpetco participates in exploration, production, refining, and marketing in Colombia and Peru. In addition, marketing is done in Ecuador and interests are held in Venezuelan crude production. Intercol was incorporated in 1951 to take over the good will and certain assets of the Tropical Oil Company, the former Colombian subsidiary which had operated in Colombia since 1919.

In the years between 1919 and 1951, the activities of Tropical Oil had been centered largely about the De Mares land concession in central Colombia. This area is still one of the principal sources of crude production in the country.

In 1951 the producing fields and associated refinery located in the De Mares concession reverted to the government according to terms of the original grant. Intercol now operates this enlarged and modernized refinery at Barranca (35,000 bbl per cal day) under an agreement with the government petroleum corporation, Empresa Colombiana de Petroleos. Intercol's facilities also include a 3500 bbl per day topping plant at La Dorada south of Barranca.

In addition to operation of the three refineries, the company is conducting intensive exploration studies for new sources of Colombian crude. Other Intpetco participations in the country's economy include essentially complete ownership of the Andian National Pipeline Corporation, which operates a 335-mile crude pipeline from the De Mares fields to the Cartagena dock terminal, a 40 percent interest in the Oleoducto del Pacífico products pipeline between Buenaventura and Cali, and 88 percent interest in Esso Colombiana, S. A., which distributes products throughout Colombia.

Marketing Operations

Principal marketing areas for the two major refineries are shown on the accompanying map. They are defined by transportation cost considerations. The Barranca refinery can most advantageously supply the area south of the central Cordillera, and the Magdalena River Valley to a point within about 100 miles of the coast. The central Cordillera is a high range of mountains over which there is commercial movement of products only by one railroad and one paved road. Cost of product movement to the West Coast by tanker is much less than overland from Barranca.

Refinery crude runs are limited by availability of a Colombian market for gasoline and distillates, neither of which is exported. Excess residual fuel is exported primarily to England, Peru and Chile. With the present crude slate, product distribution is approximately 39 percent gasoline, 30 percent distillates, 31 percent residual fuel oil.

Because of steps taken by the Colombian government to stabilize the economy of the country, short term market outlook is relatively unen-

couraging. Governmental action within the last year included freeing the peso in the world money market and clamping increasingly strict import restrictions on many items, including automobiles. It is expected that a national auto assembly plant will be in operation in 1958 with others to follow. As Colombia achieves foreign exchange balance, other import restrictions will probably be eased and market growth should again approach the historical pattern of about 7 percent growth per year, with a possible additional surge to compensate for the present period of austerity in imports. In the transitional period, adequate flexibility will permit the Cartagena refinery to operate profitably.

Intercol markets principally through Esso Colombiana, S. A., owned 88 percent by International Petroleum Company and 12 percent by private Colombian investors. Major oil companies with distribution facilities in Colombia and locally-owned marketing companies also purchase products from Intercol.

Refined Products

The Cartagena refinery manufactures liquefied petroleum gas (LPG), premium and regular grades of gasoline, kerosine, tractor and jet fuels, diesel fuel and residual fuel. The Barranca refinery manufactures these same products and in addition manufactures several grades of aviation gasoline including Grade 115/145, solvents, lubricating oils, greases and asphalts.

Barranca refinery has a design crude capacity of 35,000 bbl per cal day with its major equipment consisting of a two-stage pipestill, a combination topping and visbreaking unit, a Model IV fluid catalytic cracking unit, a sulfuric acid alkylation unit and acid recovery plant, an LPG plant, a phenol treating unit for lubes, greases and asphalt plants, light oil treating units, drum manufacturing and filling plants, and power and steam generation facilities. Because Barranca is not located near a large city many auxiliary facilities also are provided such as housing for single and married workers, mess halls, schools, medical facilities, commissaries and clubs.

Proper instrument function is vital in a minimum manpower refinery such as Cartagena Here, two Colombian instrument trainees get instruction.

The New Cartagena Refinery

The decision to construct a refinery in Cartagena was made in 1954. At that time, consumption of petroleum products was increasing at better than 10 percent per year and a market for about 10,000 bbl per day on the north coast and 8000 bbl per day on the west coast was envisioned by 1957. A site was chosen about 10 miles from the city of Cartagena to take advantage of the city's natural harbor (one of the best in the Western Hemisphere), existing dock facilities and pipeline crude supply of Andian National Corporation, and the living advantages of the city. The refinery is within 100 miles by water or land of most of the north coast market. West coast markets are served by tanker through the Panama Canal.

Design and Construction

The refinery was designed to process 26,500 bbl per cal day of either light (38 deg API) or medium-heavy (24 deg API) low sulfur crudes. Expense of this design flexibility was justified because of the wide variety of crudes which might prove available for processing and probability of discovery of new crude reserves. Basic refinery units are a two-stage pipestill, Model IV catalytic cracking unit, UOP nonselective polymerization unit, LPG facilities, steam and power generation equipment, and associated off-site facilities.

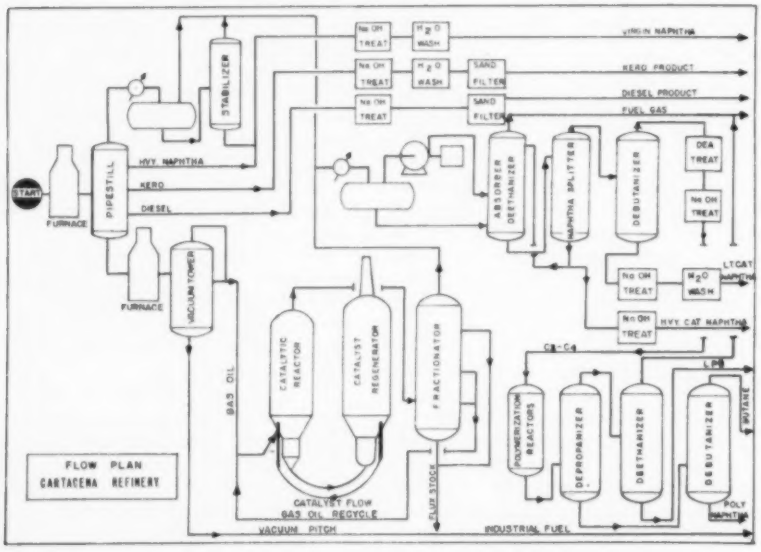
Process designs and mechanical specifications were made by C. F. Braun & Co. under the direction of Esso Research & Engineering Company. Detailed mechanical designs and the major construction work were done by Bechtel Corporation. Construction began in April 1956, and was essentially complete in August 1957 when the catalytic cracking unit was turned over to Intercol. At that time the boilerhouse and crude unit were already onstream. A peak of about 2000 workers were engaged in construction, with about 6 to 8 percent of these being North American supervisors.

All of the equipment is of conventional and proved design. This is normal practice in overseas refineries because of the great premium placed on reliable performance and because gasoline octane requirements are generally lower than in the U. S. A. The desire to employ a minimum number of expatriates, the low experience level of the nationals, and the long time lag involved in procurement of replacement parts all dictate that equipment be chosen for maximum reliability and ease of maintenance.

Process Operations at Cartagena

The refinery presently operates on 22 deg API Velásquez crude available through the Andian pipeline. Future crude choice will, of course, depend on economic considerations and availability. If sufficient satisfactory Colombian crude is not available, Venezuelan crudes will be imported. It is hoped that imports of crude can be minimized, because of the additional transportation costs incurred.

The accompanying flow plan shows the sequence of principal processing steps. Preheated crude is fractionated in the 26,500 bbl per cal day two-stage



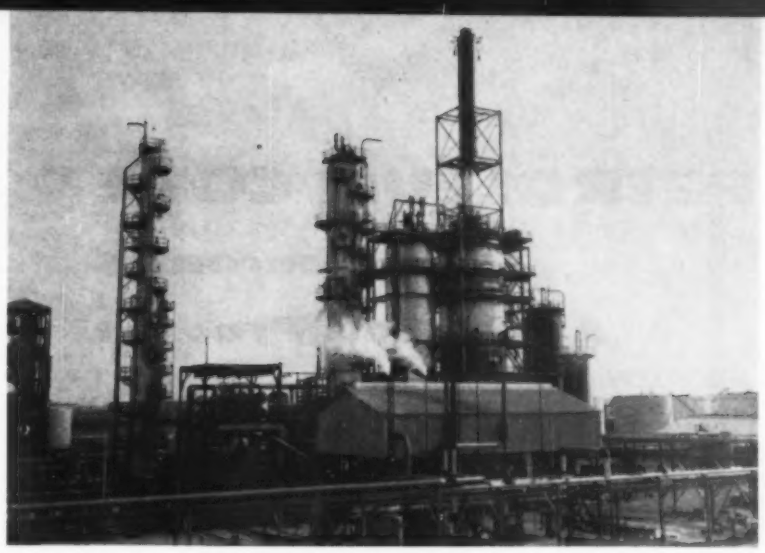
crude distillation unit without desalting (crude purchases are limited to 15 lb salt per Mbbl maximum). From the atmospheric tower, fuel gas, light and heavy virgin naphtha, kerosine, diesel fuel and 650 F+ bottoms are obtained. Atmospheric tower bottoms are fed to the vacuum unit where a single wide cut gas oil stream is taken for catalytic cracking feed, with 1050 F + vacuum bottoms line blended with catalytic flux stock for industrial fuel oil. A third tower is included in the crude distillation unit for stabilization of light virgin naphtha but has not been put into service on the heavy crude now being processed.

Virgin gas oil together with recycle stock is fed to the fluid catalytic cracking unit. This unit is designed to process 13,130 bbl per day fresh feed and 25,000 bbl per day total feed at 78 percent conversion of fresh feed to 430 F minus stock. Reactor products are fractionated to yield an overhead cut of gas and gasoline distillate, a light cycle oil sidestream for industrial fuel oil flux stock, recycle gas oil, and 1050 F + fractionator bottoms. Recycle gas oil is split into two streams to obtain a medium hot enough to reboil the splitter tower in the light ends area. Unit heat balance is maintained by regulating the amount of steam produced in the bottoms recirculation steam generators.

Main fractionator gases and overhead distillate are processed in an absorber-deethanizer tower for recovery of propylene and heavier products. Ethane and lighter is rejected to fuel gas. Tower bottoms are fractionated in a splitter to separate heavy naphtha from lighter components. Splitter overhead is fractionated to yield light catalytic naphtha and polymerization unit feed.

The non-selective polymerization unit is designed to produce 1660 bbl per day of polymer gasoline from a mixed $C_3 - C_4$ stock. Feed to the unit is treated with diethanolamine to remove H_2S and with NaOH to remove mercaptans. After a water wash, the unsaturates in the $C_3 - C_4$ cut are polymerized in six conventional shell and tube reactors. A recycle stream of butane is added to reactor feed to control the percentage of unsaturates in the feed. Products are fractionated in three columns to separate polymer, butane, propane, and residual ethane and lighter.

Gasoline and distillate products from all units are treated in a central chemical treating facilities area. Principal treating is caustic washing of cracked and virgin naphthas, kerosine and diesel fuel. Light naphtha stocks and kerosine are water washed and kerosine and diesel are sand filtered.



Largest unit in the Cartagena refinery is this 25,000 bbl per stream day fluid catalytic cracker. From left to right are the absorber-deethanizer, main fractionator, reactor, regenerator catalyst hoppers. Gas compression house is in the foreground.

With the low sulfur crudes presently processed, all product specifications can be met without further treating. Space has been provided, however, for installation of additional treating facilities if needed. The final step in product processing includes injection of inhibitors, dyes, and tetraethyl lead before transfer to product tankage.

Comments on Operations

Refinery startup proceeded smoothly and on schedule. This fact is a tribute to the Colombian employees, who number about 90 percent of the total work force and who were given an extensive pre-startup training program. Many of the Colombians had no previous experience in refineries or in any other industrial plant. In addition to the permanent overseas personnel, startup assistance was provided by 12 engineers from the Esso Research & Engineering Company and about 35 experienced operators and mechanics from affiliated refineries, on assignments ranging from 1 to 24 months.

The crude unit was started up without incident and has been operated over a range of 50 percent to 112 percent of design capacity with satisfactory results. As in many of the towers in hydrocarbon vapor service, Esso Research & Engineering Company punched tab "jet trays" are installed and have provided good fractionation and high-vapor capacity at low cost. Approximately 10 F gap between 95% and 5% points of adjacent products has been obtained at design rates. Design vacuum bottoms cutpoint has been achieved with ease.

The catalytic cracking unit also started up smoothly, after a two-week delay due to a thrust bearing failure on the main air blower and excessive vibration with the spare rotor. Catalyst circulation was established on the first attempt and has continued above the design rate of 25 tons per min. Gamma radiation equipment has been used successfully in determining catalyst densities and circulation limitations. No prolonged carbon buildups or periods of afterburning were experienced during the first month. Because of the limited rate of growth in the gasoline market, it is expected that the cracking unit will be operated below design feed rate and conversion for several years. ★ ★ ★

The Authors

J. H. Baumgartner

Antonio Donado

Jon H. Baumgartner was graduated in 1956 from the University of Wisconsin with a BS degree in chemical engineering. While on campus he was active in several engineering societies and served as associate editor of the Wisconsin Engineer magazine. After accepting employment with Intercol, he spent 10 months training in various Esso refineries in the U. S. Since arrival in Cartagena in June 1957, his assignments in the process engineering group — special problems section — have included design work, start-up assistance, and radioisotope applications.

Antonio Donado was graduated in 1950 from Colorado University with a BS degree in chemical engineering. He worked for Empresa Colombiana de Petróleos as a production engineer from 1951 to 1954. He was engaged as a commercial manager and in a business of his own from 1954 to 1956. After accepting employment with Intercol, he spent three months training at the Barrancabermeja refinery and four months at the Esso Research & Engineering Company in the U. S. Since his arrival in Cartagena in July 1957, he has been assigned in the planning and economics group.

PETROLEUM COKE becomes A Finished Product

L. E. Adee
Continental Oil Company

WHEN Continental Oil Company's Lake Charles, Louisiana, refinery started producing petroleum coke as a quality controlled, finished product in December, it marked one of the first times a petroleum refiner has calcined his coke to meet customer specifications. Previously, refiners have viewed coke as a low-grade by-product to be disposed of in the most simple manner possible.

The Lake Charles coking unit, which is designed to eliminate residual fuel oil production at Conoco's Lake Charles refinery will produce approximately 85,000 tons annually of calcined coke for industrial use and 4200 bbl daily of refinery stock for manufacturing motor gasoline.

As normally produced, petroleum coke contains a considerable amount of volatile matter which must be removed before the coke can be put to its final use. This is done by calcining at temperatures above 2400 F. With the volatile content of the coke removed, coke quality depends largely upon density and impurity content. These properties are controlled mainly by the quality of the residuum fed to the coking unit.

The new delayed coking unit will produce both electrode-grade and conventional-grade petroleum coke on a blocked-out operation. The coke drums will be cleaned with high-pressure water. Up to this point, the process is strictly conventional delayed coking.

Just below the coke drums, a steep concrete chute delivers the coke to a dewatering area where most of the water drains off to return to the hydraulic decoking equipment. From this point, a dragline moves the coke onto a drainage apron where all the free water is allowed to drain back to the dewatering zone. The drainage apron is divided by a concrete wall which keeps the two grades of coke separated.

After draining, the coke is moved to a belt conveyor which delivers it to the calcining feed silo. The dragline tower is equipped with a hinged apron that is lowered onto the curb of the drainage apron. The crane drags the coke up this apron where it falls into a hopper and drops onto a traveling belt. This hopper is equipped with a crushing device which limits lump size to eight inches.

At the end of the conveyor, the coke falls onto a grizzly screen which diverts all pieces larger than one and one-half inches to a crusher. Below the crusher, a bucket elevator lifts all the coke to the top of the feed silo. Up to this point the coke handling is intermittent, being regulated by the cycle of coke drum clean-outs.

From the bottom of the feed silo, a second elevator delivers the coke to the kiln hopper. Rate at which the coke leaves this feed hopper is controlled by the vibrating frequency of a shaker table. The shaker table discharges onto a continuous scale, which holds the weight rate of feed to the calcining kiln constant.

Here is the calciner feed silo at the Lake Charles coking unit, showing inclined conveyor bringing coke from the dragline tower and kiln feed control equipment. The waste heat boiler is behind the inclined conveyor.

It takes about two hours for the coke to pass through the kiln, where it is heated to calcining temperature. Temperature of the kiln is controlled by an automatic optical pyrometer which regulates the air flow into the kiln. Fuel gas is fed to the burner in ratio to the air rate. The heat requirement of the kiln is supplied by gas combustion with a minimum combustion of the coke or its volatile matter. Volatile matter removed from the coke is burned in a waste heat boiler by adding additional combustion air to the gases leaving the kiln.

Upon leaving the calciner, the coke must be cooled with water sprays without leaving any moisture in the coke. This is accomplished by spraying water on the coke as it travels up an inclined vibrating conveyor. The problem, of course, is to get enough water on the larger particles to cool them without mudding the fine particles. The vibrating conveyor aids greatly in this step, since it lifts the larger particles to the surface as the material travels along the conveyor. The amount of water used in the last bank of sprays is automatically regulated to give a final coke temperature of about 300 F. This assures that all water has been evaporated.

At the end of the cooler, covered elevators lift the calcined coke to any one of four silos, where it is held until loading time. After calcining, every precaution is taken to keep the coke dry. From the product storage silos, the coke is carried to the loading chutes on a covered conveyor, then shipped in covered hopper cars.

There are many characteristics of calcined petroleum coke which are related to the operating conditions of the coking unit. In the past, with coke production and coke calcining being conducted by separate industries, it has been impossible to closely correlate these variables. It is felt that, by operating the two processes in close conjunction, much better correlations can be developed; coke of a much more consistent quality can be produced. At any rate, the increased value of calcined petroleum coke justifies lifting it from the classification of a low-grade by-product, sold on an "as produced" basis, to the classification of a finished product that meets controlled specifications. ★ ★ ★

Planning and scheduling is necessary to good management; but there is too much optimism about the possibility of achieving Utopia in executing maintenance work based on a formal program. Here is the experience of one of the industry's best-known maintenance experts

LIMITATIONS to great expectations in Planning and Scheduling Maintenance Work

Creighton C. Carmine
Supervisor of Maintenance & Construction
Tidewater Oil Company
Avon (California) Refinery

TIDEWATER OIL COMPANY has two major refineries: One on the East Coast on the Delaware River with a rated crude oil capacity of 130,000 bbl per day and distinguished as the "Refinery of the Future"; the other on the West Coast near San Francisco rated at 110,000 bbl per day and known prosaically as the Avon refinery. Suggestion comes from loyal employees who have grown up with the latter to call it the "Refinery of the Past with a Future," thinking perhaps that life really does begin at 40.

The first may be likened to an attractive and enthusiastic debutante who, having just been presented to industrial society at a gala "coming out" party, looks with confidence and self-assurance toward the rising sun of the eastern horizon.

The latter, a sort of weather-beaten career woman, a spinster who has not quite found her man, is now getting her face lifted. She remembers the past with nostalgia but without regrets and, assuming an air of calm maturity, faces the golden glow of the western sky with the full knowledge that the symbol of its goals may be represented in the jeweled heavens that will surely follow the setting sun.

Avon Refinery

Ground breaking for the Avon refinery began in 1913. Age-wise therefore, it is really in its middle forties. It has expanded in scope and size over the years and in 1954, along with the construction of the new Delaware refinery, Avon began a major program of modernizing its processing facilities.

Prior to this, however, in 1951 its maintenance department had been reorganized and its maintenance procedures modernized by the introduction of a maintenance planning and scheduling system. Over the period of the succeeding six years Avon has extended, altered, and modified this system in ways to make it practical and flexible without, at any time, finding it necessary or even desirable to change or abandon its fundamental principles or basic objectives; that is, to effectively control manpower and material in maintenance and construction work.

It is the purpose of this article to briefly describe some of the difficulties encountered in the inauguration and operation of such a system. A candid review of Avon's experience indicates that there are *limitations* to planning and scheduling maintenance and construction work in an oil refinery, limitations which in one way or another may narrow the highway leading to the destination or at least roughen its surface and suggest the posting of signs saying *caution — slow*.

Premises or Conditions

A better understanding of Avon's experience will be achieved by describing the conditions under which the maintenance organization has been functioning during the years that its planning and scheduling system has been in operation. This should result in establishing a frame of reference for comparison by other oil refineries or manufacturing plants. Conditions which have prevailed would include:

1. Top management has decided on that solution to the maintenance manpower problem which provides for: (a) A permanent maintenance organi-

zation having a total complement fixed at a figure which will handle a single intermediate peak load maintenance condition while providing adequate coverage for the balance of the running maintenance requirements; (b) above average manpower used for peak maintenance loads is kept gainfully employed between peaks by a backlog of authorized work in the nature of new construction, alterations, dismantlements, fabrication for storehouse stock and deferred maintenance; (c) manpower required for major peak maintenance loads (such as that encountered during shut-downs of large processing units) is obtained by augmenting the permanent maintenance force through outside contractors normally on a cost plus basis; (d) large new construction (for example — turnkey jobs) and maintenance work requiring extensive engineering or special equipment and skills are handled by contracting the work, usually on a fixed price basis.

2. Refinery is divided geographically into three maintenance areas.

3. Maintenance organization is composed of the following divisions: (a) Field execution (including multi-craft supervision in the maintenance areas plus craft supervision in the shops and crafts); (b) planning and scheduling (short range and long range); (c) clerical. Top departmental supervision is provided to coordinate these three divisions.

4. Planning and scheduling division includes a central planning and scheduling office and also provides for decentralization (particularly with respect to field planning of jobs) into the maintenance areas.

5. Maintenance organization, and the planning and scheduling system have the support of top management, plant management, all departments of the plant, the maintenance supervisors and the labor force.

6. Maintenance department is a staff organization and has the primary responsibility for providing efficient and economical service in performing the work authorized by the line organization (processing) and other departments.

7. Maintenance work load varies from day to day as well as from week to week and is frequently subject to peak load conditions. A typical peak load situation involves using 50 percent of the available total maintenance force on a single job. Emergency and rush jobs occur, not infrequently, and their requirements have to be met.

8. Planning and scheduling system operates along the following lines:

(a) All maintenance and construction work performed by the permanent plant maintenance force is authorized by written job orders.

(b) Each job order is analyzed by a planner so as to include a brief description of the job with special instructions as to fire and safety precautions, craft man hours, craft sequences, material and equipment requirements, starting and completion dates, and job priority rating.

(c) Man hour estimates are made by planners after studying and inspecting the jobs. They are based on past performance, judgment and experience. Planners may and frequently do consult with craft foremen and mechanics in preparing estimates.

(d) All work is scheduled on a daily basis from a central planning office with weekly and monthly programs or schedules serving as targets for the larger jobs.

(e) Individual jobs are planned and scheduled to a minimum time of one hour.

(f) Some preventive maintenance programs have been developed and are in effect for the routine maintenance of equipment.

(g) A job priority system is in effect embracing three categories: Emergency (Unplanned); No. 1 Priority (carrying a definite completion date); No. 2 Priority (completion date subject to consultation with the authorizing person and with the availability of maintenance manpower).

(h) Area general foremen (maintenance area multi-craft supervisors) meet daily between 10:30 and 11:00 a.m. with the head of the planning division to schedule jobs for the following day based on priorities and the availability of manpower.

(i) A daily work schedule is issued before 2:00 p.m. each day by the central planning office to all maintenance areas and crafts, listing all jobs to be performed the following day by each craft with the estimated man hours for each job. The daily work schedule also indicates the major automotive vehicles and portable equipment required for the various jobs.

(j) Stores material control procedures are in effect embracing; Stock inventory control, scheduling of material procurement, refinery-wide distribution of stock catalogs, efficient material delivery service from storehouse to field and shops.

(k) Plant is unionized along industrial union lines with a traditional division of maintenance labor into crafts and into skilled, semi-skilled and unskilled classifications.

Now that some of the operating conditions have been defined let us proceed to examine a few of the **limitations** which have been encountered at Avon in planning and scheduling maintenance work.

Limitations are discussed from two different viewpoints: (a) Those resulting from factors outside of the maintenance planning and scheduling system, and (b) those determined by factors inside the system.

Limitations from Outside

First. The system must have continuing acceptance and support from top

management and from all plant personnel affected by it, directly or indirectly. If the plant is growing and expanding, top management should not expect that the planning and scheduling system will necessarily result in a *decrease* in maintenance manpower at the same time there is an *increase* in work load, the latter clearly indicated by increased work authorizations. It is essential that top management have confidence that the system, when finally stabilized and working properly, has reached a point of adequate returns and that it will continue to utilize labor and material as required in an efficient and orderly manner.

In this connection, it seems to me that it is not asking too much of top management that, in the introduction of a maintenance planning and scheduling system, at least in an oil refinery, very *large* results not be expected in a very *short* time. Planning and scheduling is a phase of scientific management introduced, I believe, into the industrial system of this country during the early part of the century. This is what one of the pioneers said about scientific management in 1912. Appearing before a special congressional committee, Frederick W. Taylor stated:

"It has been my experience that, if a man starts to introduce the principles of scientific management into any company, unless the owners of that company — the directors, the people who have the final power — unless they want it and want it badly, and understand the price that has to be paid for it, and that price is one of long time and patience, my advice to him was that you let that thing alone."

Second. A maintenance planning and scheduling system is limited in its operations by the character of the process department's schedules upon which any maintenance planning and scheduling is based. Process units and equipment should be scheduled for overhaul and repair on a practical and realistic basis with considerable regard for the long range view. Knowing that there will be peak loads during shutdowns and major overhauls, the maintenance organization should know within reasonable limits, when they will occur so that manpower for the peaks may be predicted and commitments taken for meeting schedules pertaining to other maintenance jobs and to the backlog of so-called project jobs which utilize the above — average maintenance manpower between peaks.

It is true, of course, that the process department's equipment overhaul schedules may be determined or seriously affected by factors outside of the refinery, such as crude oil delivery schedules, sales forecasts, and lifting of finished products.

"So this is how you solve the job priority problem!"

Third. The system will not function properly if authorizing personnel do not allow a reasonable planning interval between the issuance of job orders and the times of starting the jobs. Each job has to be analyzed by a planner. Sketches or drawings may have to be prepared, special material and equipment provided, manpower scheduled, and the requirements of the job briefly reviewed by field execution personnel who are going to perform the work. If an adequate planning interval is not allowed, jobs become "emergencies" and therefore unplanned. A preponderance of this type of work authorization and you don't have a planning and scheduling system.

Fourth. Satisfactory performance is limited by the amount of adherence obtained to a job priority system and such a system should be both simple and practical. It should operate in accordance with known operating priorities and with stream-lined procedures for resolving conflicts. It should provide for quick referral, where necessary, to a single ultimate authority. I believe that anyone who has had experience with a maintenance planning and scheduling system will agree that, without a functioning job priority set-up, the situation becomes one bordering on *chaos*.

Fifth. Efficient operation of the system will be considerably limited if there is inadequate planning and scheduling of engineering design and material procurement, the latter involving tracing and expediting, storehouse stock control, current cataloging of stock materials, and rapid material delivery service to shop and job-site.

Sixth. Planning and scheduling will be hampered if there is a lack of standardization throughout the plant. By this I mean: Material standardization, standard operating and maintenance procedures, standard accounting procedures, standard fire protection and safety requirements.

Seventh. Lack of flexibility in the labor agreement will make good planning and scheduling difficult if not virtually impossible. The daily fluctuating work load in an oil refinery requires considerable latitude in upgrading labor classifications and transferring semi-skilled and unskilled workers between crafts on a temporary basis to meet changing conditions. A labor agreement which prohibits or restricts this imposes severe limitations on the planning and scheduling function.

Eighth. If the basic premises under which the maintenance organization was established are changed or if they keep fluctuating, then the operation of the planning and scheduling system becomes erratic. It is faced with the

"Ever thought of buying a tool box, McDull?"

necessity of meeting continuing altered conditions which in time will create disorder and frustration.

For example, suppose you are planning from a maintenance forecast and have figured on a certain fixed complement of personnel in your maintenance organization to provide a proper balance between crafts for carrying out the forecast. Then suppose your maintenance force is arbitrarily cut 25 percent. The original premise of the maintenance forecast has not been changed but the organization set up to meet the forecast has been altered.

As a result you do one or more of several things: (a) Defer maintenance jobs; (b) fail to do some maintenance work at all, or (c) contract more maintenance. The first two disrupt preventive maintenance programs and result in unscheduled breakdowns, costly equipment failures and the inevitable deterioration of the plant. Advisability of the third course of action is in my opinion, very debatable from the standpoint of cost and work performance.

At any rate, arbitrary changes of this nature will limit the satisfactory functioning of planning and scheduling by creating apprehension, uncertainty and confusion.

Limitations Inside the System

Now for some introspection. Let us take a look at the workings of the system from within and see what **limitations** are encountered. There are a number of them which should be understood and reckoned with in appraising objectives, methods and results.

First. Consider the quality of the job analyses performed by the planners. A planner must look at the job, analyze it into its component parts, describe a method of performing the job which is practical and efficient, indicate a logical time schedule for performing the work and provide for the delivery of the necessary materials to the jobsite concurrent with the manpower.

Second. Proper functioning of the system with respect to planning and execution is affected and limited by the availability of transportation for personnel, material, and equipment to and from the jobs and between jobs in order to provide job continuity and to prevent loss of work activity by reducing so-called "dead time."

Third. It is essential that all personnel in the maintenance organization be thoroughly indoctrinated and instructed in their duties and responsibilities under a planning and scheduling system. Relationship between the planning function and the field execution function has to be clearly and continuously explained by verbal and written instructions with constant follow-up and arbitration of disagreements and misunderstandings.

Fourth. Examine the very important problem of disseminating information. This too is a *must* and is accomplished through written instructions, information bulletins — widely distributed. Written work is augmented by daily, weekly and monthly meetings for the coordination of plans and for the exchange of ideas and information.

It is necessary that a plan or a schedule promulgated by the planning staff be known and understood by all who are affected by them. It is mandatory that any changes made by planning or by field execution become known to all who are involved directly or indirectly in the changes. In the maintenance organization which we have described there was incorporated a central planning office with the responsibility for issuing a daily work schedule after a daily conference between representatives of planning and a field execution. Changes made following the issuance of the daily work schedule **must be cleared with the central planning office.** In the cases of emergencies (which are *real* emergencies) action may have to be taken immediately in the field to divert men and equipment from planned work. It is essential, however, that the central planning office, which is the clearing agency for the allocation of manpower in accordance with job priorities, be notified of the changes as soon as possible.

To be convinced of the limitation imposed on the smooth operations of a maintenance planning and scheduling system, all that one has to do is to be at the hub of such a system, the central planning office, and observe the confusion which reigns when manpower in the field is diverted from planned work and the fact is kept a secret.

Fifth. An optimum balance between planning and field execution should be maintained and a continuing follow-up by top maintenance supervisors inaugurated to see that the balance is preserved. Field execution must not be hampered by too much paperwork and it must not be robbed of its initiative. After all "the work has to get done," regardless of the paper work. A planning and scheduling system is intended to assist field execution by scheduling jobs, manpower and material, providing realistic and practical targets and coordinating the various jobs going on simultaneously throughout the refinery. It is virtually impossible for field execution alone to keep track of 200 jobs going on at the same time involving 14 crafts, 2 to 6 crafts per job, and the time sequencing of crafts and equipment on those jobs requiring sequencing which may number between 10 and 15 percent of the total number on any one day.

Assuming that the planning program

The Author

Creighton C. Carmine is the supervisor of maintenance and construction at Tidewater Oil Company's Avon Refinery, in Associated, California. Considered to be one of the country's outstanding experts in the field of refinery maintenance, he is a frequent speaker at meetings, and has published several articles, many of which have appeared in The Refining Engineer.
A 1918 graduate of the United States Naval Academy, he also holds a master's degree in Mathematical Physics, granted by University of Chicago in 1925.
Mr. Carmine first joined the Avon refinery in 1928, when it was held by Associated Oil Company, and has spent a total of 25 years in the refinery organization. Several advancements in the mechanical department led him to his current post, which was gained in 1955.

is sound and that the detailed plans to accomplish it are practical, then field execution should do everything possible to follow the plans and not deviate from them prior to consultation with planning.

Sixth. The system is sometimes limited by the amount of formal planning, controlled by the central planning office, which is attempted. This varies, of course, with different plants but in general it is better in those of any size to augment the formal central planning function with a certain amount of decentralized semi-planning in the field in the maintenance areas. For example, every oil refinery encounters a certain amount of work involving jobs of small duration on the order of 15 minutes, a half-hour or one hour. The type of work which comes to mind includes such characteristic jobs as: Blind changing, hooking up tank cars, packing leaky valves, minor piping repairs, daily routine checking of pumps and compressors. If these types of jobs are formally planned and routed through the central planning office, the paperwork would become burdensome beyond the point of vanishing returns.

At Avon, we have found it better to decentralize the planning and execution of these small jobs into the three maintenance areas. A minimum number of pipefitters, machinists, electricians and instrument repairmen are assigned to the maintenance areas and these perform small, single-craft jobs authorized in writing on minor maintenance request forms and handled entirely by the maintenance area office supervisory or clerical personnel.

Seventh. Practical considerations limit the amount of planning which can be done. There is a balance to be achieved between too much and too little planning. At Avon we started "great guns" to plan everybody and everything in maintenance and we were very soon in trouble. After taking a good look at things, followed by many moves of a trial and error nature, we have stabilized the system and are now planning and scheduling between 75 and 80 percent of the available daily rated manpower. This includes the operators of major automotive equipment (other than light vehicles used for supervision and inspection) and is the result of 6½ years' experience. I doubt that we would strive for any higher percentage.

Eighth. The value received for planning and scheduling must bear a favorable relationship to the additional cost incurred. Two avenues of approach to this phase of the problem have occurred to us: (a) The net decrease in payroll as a result of introducing such a system, and (b) the reduction in maintenance and repair costs. In the first approach, it will be noted that you add planning and clerical personnel to your maintenance organization but that, if matters work out as expected you get control of your manpower, tailor the labor effort required for all jobs, coordinate men and material better, and wind up by requiring a smaller number of direct or daily rated so-called "productive" workers. This has been the result at Avon. The maintenance force was first increased by 3 percent and, when the system was finally working smoothly, there was an overall reduction in the total maintenance force of 15 percent. I have been reliably informed that other plants which have introduced a planning and scheduling system have effected reductions as high as 20 percent in the maintenance force.

The second approach is a bit tricky. It requires a comparison of the situation prior to the introduction of the system with the situation afterward — on a **common cost basis.** One yardstick which may be used for this purpose is the ratio of maintenance and repair costs to total plant investment. Both terms in the ratio should be corrected to the same cost level so as to eliminate the factor of inflation. Again the experience of Avon has been a reduction in this ratio on the order of 15 to 20 percent during the course of establishing a maintenance planning and scheduling system.

Ninth — and very important. Our initial set of conditions described a maintenance organization with a fixed complement of personnel. The stipulation was included that peak maintenance loads would be encountered at fairly frequent intervals and that the above average manpower required on peak loads would be gainfully employed between peaks on authorized work involving new construction, alterations, dismantlements, fabrication for storehouse stock, and deferred maintenance. The satisfactory operation of the planning and scheduling system is **limited** by the existence of such a "between-peaks backlog" of authorized work.

I have listed this item as: **A limitation inside** the system. Actually and legitimately perhaps it belongs as a limiting factor **outside** the system, because our maintenance department functions as a service organization on the basis of written authorizations from other departments. It would appear, therefore, that to make the planning and scheduling system work properly under the conditions outlined, adequate backlog of this so-called project work must be authorized from **outside** the maintenance department.

Conclusion

This concludes discussion of the factors tending to affect or limit the operation of a planning and scheduling system for maintenance work in an oil refinery. Undoubtedly there are many others. I hope, however, that I have covered some of the important ones and I can assure you that the limitations described are by no means hypothetical.

Despite the limitations encountered in a maintenance planning and scheduling system we feel that it is reasonable to expect the following results by virtue of having adopted one:

1. A reduction in maintenance manpower on the order of 15 percent.
2. A reduction in maintenance and repair costs averaging 15 to 20 percent.
3. Better servicing of process equipment and facilities.
4. An orderly way of doing things in the field of maintenance.
5. Less stress and strain on the network of human nervous systems involved — a qualitative gain but a **real** one. ★ ★ ★

PETROCHEMICALS VIA THE OXO PROCESS

Peter W. Sherwood
Chemical Engineer
White Plains, New York

Part 1. Products of the Oxo Process and Their Markets

OXO CHEMICALS are obtained by the reaction of olefins with carbon monoxide and hydrogen. The primary products are aldehydes and alcohols, containing one carbon atom more than the parent olefin. The reaction is highly versatile. It permits the use of a large variety of feedstock hydrocarbons, and several derivatives are obtainable from a given starting material.

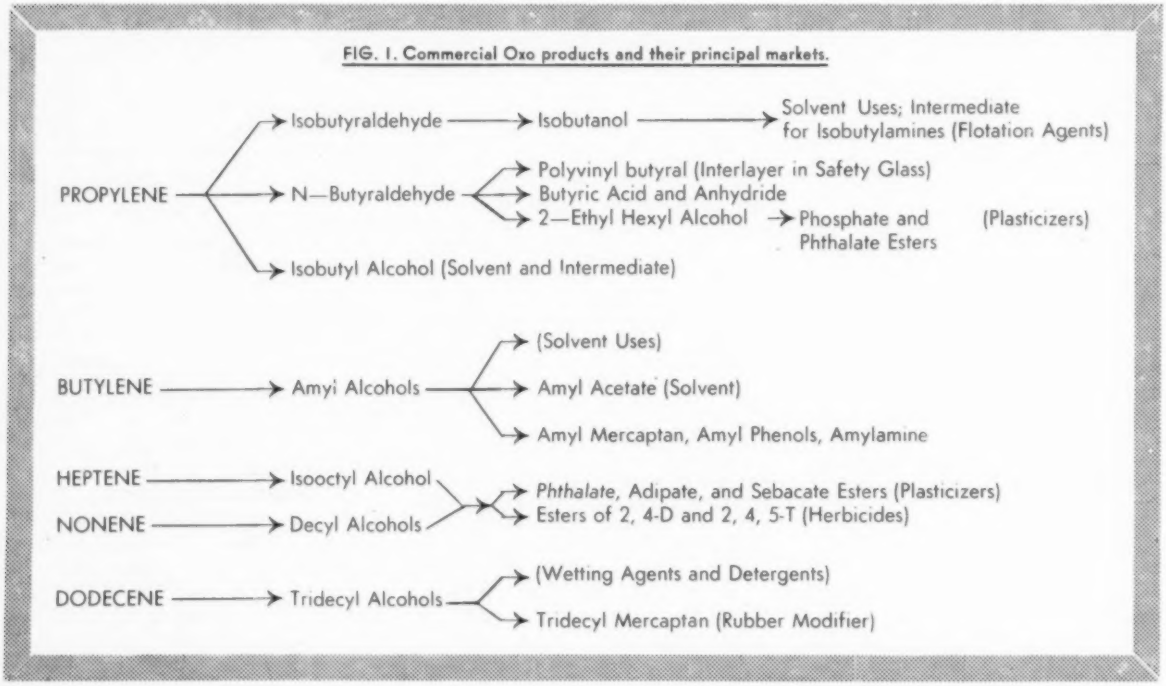
Products

In the strict sense of the word, the product of the Oxo reaction is a mixture of aldehydes. Above the C_6-range, these heat-sensitive compounds can be separated from the crude product only with difficulty. The higher aldehydes are therefore not recovered as such. Instead, they are subjected to hydrogenation at reaction conditions which resemble those of the Oxo stage, and the resulting alcohols are refined and sold as such. Thus, the Oxo process serves today for the commercial production of only two aldehydes (namely, butyraldehyde and isobutyraldehyde) and a series of alcohols (butyl, amyl, octyl, nonyl, decyl, and tridecyl alcohols).

In each instance, the plant product is a mixture of several alcohols. It is not practicable to isolate the individual higher alcohols, and the marketed product is actually a mixture of C_8, C_{10}, or C_{13} alcohols. It is important to note, however, that the components of these mixtures are almost wholly *primary* alcohols.

Instead of converting the Oxo aldehydes to their corresponding alcohols, one may oxidize them to fatty acids which can be separated from the crude product by alkaline extraction. This approach is not today in commercial use for the higher Oxo alcohols (butyric acid is obtained from butyraldehyde in this fashion), but such a process for the production of isooctanoic acid has been taken through the pilot plant stage.

FIG. 1. Commercial Oxo products and their principal markets.



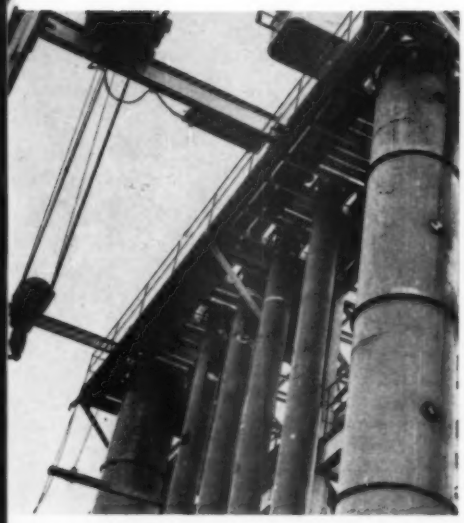


FIG. 2. Heart of the Oxo process is the high pressure, catalytic reactors. This plant, operated by Texas Eastman Company, produces normal and iso-butyraldehyde.

— Courtesy Texas Eastman Company

The Oxo reaction has several obvious attractions to petroleum refiners. It offers direct utilization for higher olefins; all the raw materials involved are derivable from petroleum sources; it permits synthesis of a number of useful oxygenated chemicals which cannot be produced economically by any other route; a variety of products can be manufactured in a given installation, as may be called for by the market.

Oxo Alcohols Plants in USA

Oxo operations were started in the United States in the latter part of 1948. Today, there are five producers in the field (a sixth Oxo unit was operated for only a brief period around 1950). Their estimated plant capacities and principal Oxo products are summarized in Table 1. These capacities can be expressed as rough approximations only because the possible output increases with the feedstock's molecular weight (up to about C_{15}-C_{16}); to carry out the Oxo reaction with higher olefins and in good yield, would necessitate equipment revisions.

Two aspects of Table 1 are particularly noteworthy. First, three of the five commercial producers of Oxo chemicals are basically petroleum refiners. Second, the bulk of Oxo operations is directed toward the manufacture of alcohols in the C_8-C_{13} range. Products of lower molecular weight make up only a small portion of capacity.

Therein, American practice differs from application of the process in Europe where synthesis of light hydrocarbons is emphasized. Thus, Imperial Chemical Industries produces butanols in its No. 2 carbonylation (i.e. Oxo) unit at Billingham, reportedly the world's largest plant based on this process. Billingham's smaller No. 1 carbonylation unit is used for the synthesis of alcohols in the C_8-C_9 range.

General Economics; Market Demand

The point is, of course, that the lower aldehydes and alcohols are also readily obtainable from alternative sources, which generally have a competitive edge at conditions which prevail in the United States. The share of the Oxo synthesis in the output of C_4 and C_5-alcohols is estimated at about 25 million lb in 1956, less than five percent of total production. There is no evidence that developments of the near future will make oxoation a larger factor in this field. Nevertheless, this route to the synthesis of lower alcohols holds attraction because of its versatility which permits the manufacture of different products in a given plant, by merely changing the olefinic feedstock and making minor adjustments in operating conditions.

It is in the synthesis of the higher primary alcohols that the Oxo process is uniquely useful. There are alternative commercial routes to some of these alcohols (e.g. 2-ethyl hexanol is being produced from butyraldehyde). However, such competitive methods are available for a few specific alcohols only. The bulk of octyl, decyl, and tridecyl alcohols manufactured today are economically attainable by the Oxo route only. All of these alcohols may be, and are being, produced in the same commercial facilities. (Manufacture of another Oxo alcohol — nonanol — had a brief commercial career in the United States where it has now been discontinued for lack of sufficient markets. Production of nonanol by the Oxo route is still practiced in England.)

Despite strong competition in their major uses (principally in plasticizers), production of C_8-C_{13} alcohols has shown a fairly gratifying growth rate. Since 1948, the first year of Oxo operation in the United States, output of these alcohols rose to 25 million lb in 1954 and about 70 million lb in 1956. A recent estimate[1] forecasts production just short of 100 million lb in 1957, near 140 million lb in 1958.

At present, the principal markets for Oxo chemicals are in highly competitive fields. In the C_4-C_5 range, alternative production routes for the same alcohols are available. The C_8, C_{10}, and C_{13} Oxo alcohols must bear the competition of related alcohols which serve the same end uses; only to a very limited extent has it been possible to sell Oxo products on the basis of superior chemical properties.

Markets for Oxo Chemicals

To evaluate the future outlook for Oxo activities, it is necessary to take a look at the overall markets for the individual chemicals derived by this route and, within this field, to consider the position of Oxo products vis-a-vis competitive materials. This will be the approach taken in the following discussion.

1. C_4- and C_5 Oxo chemicals.

In the manufacture of **n-butyraldehyde,** the Oxo process takes second position. In the predominant process, acetaldehyde serves as raw material. Two moles of acetaldehyde are condensed to crotonaldehyde which is hydrogenated to n-butyraldehyde. In addition, some butyraldehyde is obtained by the oxidation-dehydrogenation of n-butanol.

N-butyraldehyde finds important utilization as intermediate in the production of butyric acid and its anhydride. One of the most significant reactions of butyraldehyde is with polyvinyl alcohol to form polyvinyl butyral. PVB is used extensively as an interlayer in safety glass as well as for coating fabrics and in lacquer formulations. The self-condensation of butyraldehyde and subsequent conversion to ethyl hexyl alcohol has assumed significance as a step in the production of the plasticizers trioctyl phosphate and dioctyl phthalate; condensation of butyraldehyde with phenol yields an important class of oil-soluble resins.

Markets for **isobutyraldehyde** are more confined. They are being developed along the lines of outlets from n-butyraldehyde. Its derivative, isobutanol, can serve for the production of isobutylamines, intermediates in the synthesis of some flotation agents and rubber accelerators. This alcohol also finds application as solvent in lacquer formulations.

TABLE 1. Oxo Operators in the United States.

Company	Plant Capacity (Million lb/yr) (Estimated)	Principal Products
Carbide & Carbon Corporation	60*	Amyl, isooctyl, decyl, tridecyl alcohols
Esso Standard Oil Company	50	Isooctyl, decyl, tridecyl alcohols
Tennessee Eastman	25**	Isobutyraldehyde, n-butyraldehyde, isobutyl alcohol
Amoco Chemicals (Standard of Indiana)	15	Isooctyl, decyl alcohols
Gulf Oil Corporation	15	Isooctyl, decyl, tridecyl alcohols

*Being expanded.
**Expansion now underway for production of higher alcohols.

1. Chemical and Engineering News, March 18, 1957, p. 66 ff.

N-Butanol's principal source is acetaldehyde. This method of synthesis is similar to that for n-butyraldehyde, except that final hydrogenation calls for more drastic conditions. N-butanol is a solvent for urea-formaldehyde, cellulosic, and alkyl resins. It is employed as raw material in the production of a number of industrially important esters, among them dibutyl phthalate (a plasticizer) and butyl acetate (solvent for nitrocellulose). Butylamines, formed by the reaction of butanol with ammonia serve in the manufacture of a number of resins and flotation agents.

Amyl alcohols find use as solvents for nitrocellulose lacquers, urea-formaldehydes resins, etc. Individual isomers serve as intermediates in the synthesis of amyl acetate (a solvent and odorant), amylamine (for the textile industry) amyl mercaptan (a gas odorant), amyl phenols (drying agents and solvents).

The Oxo-produced amyl alcohol is principally 3-methyl butanol-1, obtained from isobutylene. Foremost source of synthetic amyl alcohols is a process which involves vapor-phase chlorination of pentane, followed by hydrolysis.

2. Higher alcohols.

Some 85 percent of the demand for Oxo C_8 and C_{10} alcohols is in the manufacture of plasticizers for polyvinyl chloride resins. Most important of these products are the derivative phthalate esters, with adipates, and sebacates in a lesser position.

Future expansion in this field is influenced by four primary aspects of the market: Competitive alcohols, competitive plasticizers, overall trends in plasticizer consumption, and demand for polyvinyl chlorides. Unquestionably most of the sales of Oxo alcohols to producers of plasticizers have been achieved at the expense of 2-ethyl hexanol. Even so, this derivative of butyraldehyde continues to be in number one position among alcohols for plasticizers. It is used principally in the form of 2-ethyl hexyl phthalate which still shows a modest growth trend. Production of this derivative of 2-ethyl hexanol has risen from 51 million lb in 1949 to 72 million lb in 1955 and to 80 million lb in 1956.

Other alcohols, as well, provide competition in the plasticizer field, though on a more limited scale. Capryl alcohol, a by-product of sebacic acid manufacture, finds application in the production of mixed phthalates. It might be noted that this is the only secondary alcohol for which a significant market exists in the plasticizers field.

From a performance point of view, ester-type plasticizers offer certain advantages if they are produced from straight-chain primary alcohols. C_8 and C_{10} alcohols of this type are commercially available from the hydrogenation of coconut oil fatty acids or esters. They offer strong competition to Oxo alcohols where special aspects of product performance over-ride purely economic considerations.

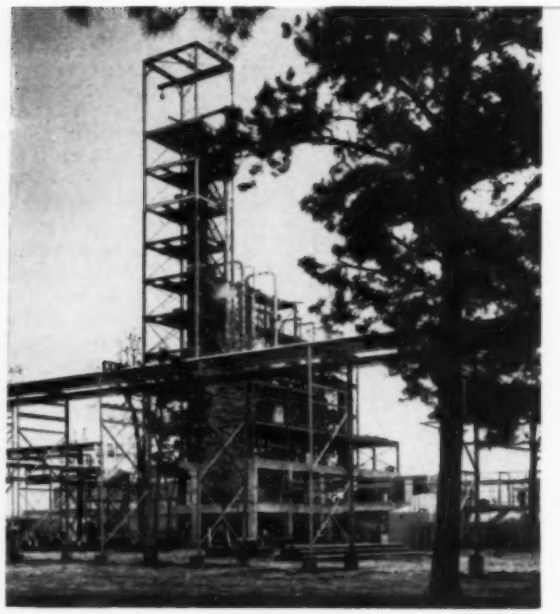


FIG. 3. Crude normal and iso-butyraldehydes coming from Texas Eastman's catalytic reactors are separated and refined in this distillation equipment. Part of the 2-ethyl hexyl alcohol process is also carried out here.

— Courtesy Texas Eastman Company

Phthalate esters are the workhorses among PVC plasticizers. To an increasing extent, however, these compounds must meet the competition of some 200 other commercial plasticizers, most of which do not contribute to the market for Oxo chemicals. Plasticizers are chosen on the basis of cost as well as of properties required by the intended use for the plastic product. They are not fully interchangeable and the share of specialty plasticizers in the overall PVC market is growing.

The growth curve for PVC plasticizers as a whole falls short of the trends exhibited by polyvinyl chloride itself. This is due to a growing market for rigid vinyls which use little or no plasticizer and also due to the expanding field of internally plasticized copolymers of vinyl chloride with other monomers. Result is a decline in the ratio of plasticizer to total plastic product.

Finally, expansion of markets for Oxo-based plasticizers is affected by the inroads made by competitive plastics on total polyvinyl chloride sales. Polyethlyene has been an important factor in this field, but other plastics and products (such as fiberglas fabrics) have also shown strong competitive influence in polyvinyl chloride markets.

Other Uses of C_8, C_{10} Oxo Alcohols

While production of plasticizers is the predominant outlet for C_8 and C_{10} Oxo alcohols, the tridcyl alcohol mixture finds its principal use in the manufacture of detergents and wetting agents. Two types of detergent are important as consumers of Oxo chemicals: A nonionic detergent which is formed by condensation of tridecyl alcohol with ethylene oxide and an anionic, sodium tridecyl sulfate. Each of the remaining markets for the higher Oxo alcohols accounts for only a relatively small portion of the market. Among the established outlets, we might mention the production of tridecyl mercaptan, which has during the last two years found growing acceptance as rubber modifier, in lieu of more costly dodecyl mercaptan (produced from coconut alcohols.)

An application of potential interest is the manufacture of Oxo alcohol esters of 2, 4-D and 2, 4, 5-T to be used in lieu of the ethyl, propyl, and butyl esters which have a wide market as herbicides. The product of the higher alcohols is less volatile and therefore less subject to drift which might damage pay crops.

Other applications of actual or potential value include the use of Oxo nonyl alcohols to suppress sprouting of potatoes in storage, the manufacture of dibasic esters of Oxo alcohols to serve as specialty lubricants for turboprop and turbo-jet engines, uses in lacquer solvents, antioxidants, odorants, etc.

To summarize, the higher Oxo alcohols have a few large established markets which are highly competitive. Other uses now on the horizon promise to add significant demand. Further market development is not limited to a particular product but to a large line of related alcohols, all of which can be produced by the versatile Oxo process in the same plant facilities.

Part 2, *Chemistry of the Oxo Process*, will be published in the March issue of THE REFINING ENGINEER.

Here's how Clark Oil & Refining solved a tough problem . . .

Prevention of Discoloration and Sludge Formation in Catalytic Furnace Oil

Strong caustic washing improves quality, new accelerated storage test measures results

Kenneth A. Buchanan
Robert H. Bruggink
Clark Oil & Refining Company
and Charles D. Lowry, Jr.
Consultant

SLUDGING and color degradation of light distillates, particularly No. 2 furnace oil, have plagued the oil industry since thermal cracking was inaugurated and have become a much greater problem since the advent of catalytic cracking. Not that the catalytic fractions were more troublesome than thermal, but increased demand for middle oils necessitated their use in furnace oils and diesel fuels. As a result, nearly every refiner is faced with two problems: First, how can he produce finished middle oils containing cracked components that will not darken and sludge, and second, what tests can he apply before he ships the oils to be sure that they are stable?

Clark Oil and Refining Company, faced with unstable color and sludge formation in their No. 2 furnace oil, largely a catalytically cracked product, has succeeded in producing by caustic washing a product remaining for long periods consistently stable as to color and sludge. They also have developed, to guide their treating operations, a control test that is dependable in their oils.

They do not cherish the illusion that the methods used are universally applicable. Refining middle oils is a problem of great complexity and many ramifications. No more proof of this is needed than the vast amount of research, recent and current, done in this field, sponsored by the Bureau of Mines, the Navy, the Air Corps and nearly every large refiner. This research has shown conclusively that there is no single best way to refine middle oils. Use of additives, chemical reagents, and hydrogenation all have their place. Nor is conformity to any single analytical test proof that every oil is satisfactory. Heating tests, filtration studies, examination of sludge by chemical means on the electron microscope all are useful.

The problem faced by the Clark Company was simplified by several factors. The company produces middle oils of substantially uniform properties from a crude of constant quality. It has a single cracking unit which is operated under fixed conditions. This made possible the adoption of a single treating method and correlation of a rather arbitrary accelerated test with long time storage results. It is hoped that narration of the steps in the development of this correlation will help other refiners.

During the 1952 heating season, severe color depreciation and some sludge complaints were encountered with No. 2 furnace oil. A large volume of the oil had to be rerun.

Plant Operating Conditions

At this time, the refinery was running about 15,000 bbl per day of low sulfur, Mid-Continent pipeline crude. It was first desalted by conventional means, using Tretolite and caustic soda. Then as the first topping step, light gasoline was removed. In the main fractionating tower, heavy gasoline was taken overhead with these side cuts produced:

550-575 F	E. P. Range Oil
615-620 F	E. P. Diesel Oil
700 F	E. P. Catalytic Cracker Charge

The bottoms were further reduced under vacuum to produce additional cat cracker charge and either asphalt or No. 6 fuel oil.

No. 2 furnace oil was produced in the Houdriflow catalytic cracker which at that time was operating under the following conditions:

Reactor temperature 900-905 F
Recycle ratio 0.22
Catalyst to oil ratio 6.4
Conversion 58-59%

The physical and chemical characteristics of the No. 2 fuel oil were approximately as shown in Table 1.

Strong Caustic Washing Improves Quality

At the time the instability of the oil was encountered, treatment being given was a scrub with dilute caustic soda solution, usually 7 to 10 Baumé. It was injected into the oil stream just before it passed through a baffled emulsifier. Oil was then passed through a settler and to storage. Most of the time the wash seemed to be doing the oil more harm than good.

Tests in the laboratories of Universal Oil Products Company indicated that an efficient caustic wash would definitely improve the oil. Work in Clark's own laboratory showed that within limits, the higher the caustic concentration, the greater the beneficiation. Accordingly, the caustic concen-

tration in the wash was raised to between 25 and 30 Baumé (80 to 105 lb per bbl).

Plant treatment with strong caustic when first introduced was checked by treating in the laboratory with caustic of the same concentration. At first the laboratory treating gave an oil substantially more stable than was produced in the plant. Study showed that the oil was treated at too high a temperature, settling was not adequate and there was some caustic carry-over. Another settler was added, and additional cooling installed to allow treatment at not over 80 F. A salt filter was placed in the system to clarify the oil. A flow diagram of the modified treating plant is shown in Fig. 1. After these changes, the plant treated oil tested and stored as well or better than the oil treated in the laboratory.

TABLE 1.
Properties of Catalytic No. 2 Oil.

Gravity, °API	30.0
Distillation	
IBP	360 °F
10	480
50	520
90	585
E. P.	620
Sulfur, %	0.30
Viscosity, SSU @100 F	38
Flash point, C. O. C.	185 F
Cloud point	5 F
Pour point	0 F
Color NPA	1¾
Aniline point	125 F
Cetane No. (Cal)	42
Carbon residue	0.004%
Carbon residue 10% residue	0.060%
Ash	Nil
Bromine No.	7.0
Unsaturates, %	8.0
Aromatics, %	43.0
Mercaptan sulfur, %	0.002—0.004%

Accelerated Storage Test Devised

To control treating, an accelerated test was needed. As such a test, a method was sought which by its severity would insure that every sample of oil which was unstable would be detected. Test adopted was exposure of a small oil sample in an oven to a temperature of 230 F for periods of 24 and 48 hours. Data from this test were compared with results of storage of the oil in the laboratory in the dark in nearly filled, open, four-ounce oil sample bottles. Storage tests at laboratory temperature are undoubtedly considerably more severe than tank storage in the plant, as the laboratory was not below 70 F in the winter and substantially warmer in summer. Oil alone, without water or iron, was placed in the bottles, as it was not believed that presence of a water layer and a piece of metal in the bottle, expedients sometimes used, would accurately reproduce the effect of water bottoms and tank walls in a large tank.

In four years use of these test methods, two correlations, admittedly rather rough, have been established.

1. In both the accelerated tests and the long time storage at laboratory temperature, color stability and sludge formation run parallel. Oil remained sludge-free until it reached approximately three color. It usually began to form sludge when it had darkened somewhat beyond this value.

2. Rate of discoloration and time of beginning sludge formation in ambient temperature storage was approximately predictable by the behavior of the oil accelerated test.

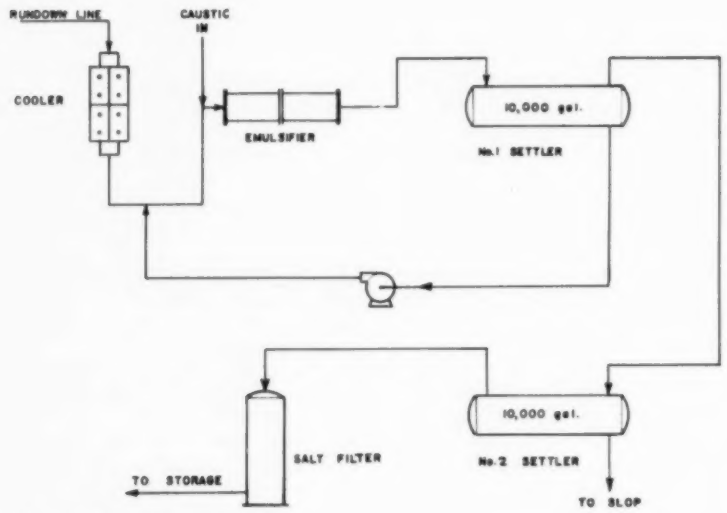


FIG. 1. No. 2 fuel oil treating system.

The beginning of sludging was detected by visual observation of the sample, swirling the bottle to make the sludge more visible.

If the color exceeded 3¼ NPA after 24 hours in the oven, life in dark storage to three color was approximately 100 days. If color was less than 4¼ after 48 hours, the dark storage time without excessive discoloration was 200 days or longer. If in the oven sludge formed within 24 hours, it would usually form in 70 to 90 days of room temperature dark storage. If sludge was not formed in this time, storage period without sludge at room temperature was at a minimum 180 to 200 days and in some cases no sludge was observed in over 600 days of dark storage. If the color went beyond five after 48 hours in the oven, the oil would not store well, and sludge would form after short storage, sometimes within 80 days.

Application of Correlations

How these correlations were worked out is shown in Fig. 2, which gives results on the untreated oil. Fig. 3 presents results on the caustic washed and salt filtered product. The lines relate color to oven exposure and to days in dark storage. Arrows indicate times when, on the average, sludge formation was first observed.

While most of the storage results conformed fairly closely to the averages shown in the graphs, there were a significant number of samples better and worse than the average. Source of these differences could not be found in the treating operation and data such as that in Table 2 led to a belief that they originated in variations in the cracking operation.

From the variation in catalyst oil ration and vapor temperature, it appears that over severe cracking may produce unstable oil. When this condition was encountered, attempt was made to improve results by lowering the end point and sharpening the fractionation.

Trace Components Cause Deterioration

Research on middle oils has shown that in sludge formation the bulk of the oil is not involved, but the responsible factors are components present in low concentration. Bender[1] showed that isolated sludge was high in sulfur and nitrogen, and also contained carbon, hydrogen, and oxygen. He believed the mechanism of deterioration might be either the direct oxidation of sulfur and nitrogen compounds or acceleration of the oxidation of hydrocarbon components, particularly substances with aromatic nuclei, by the influence of sulfur and nitrogen com-

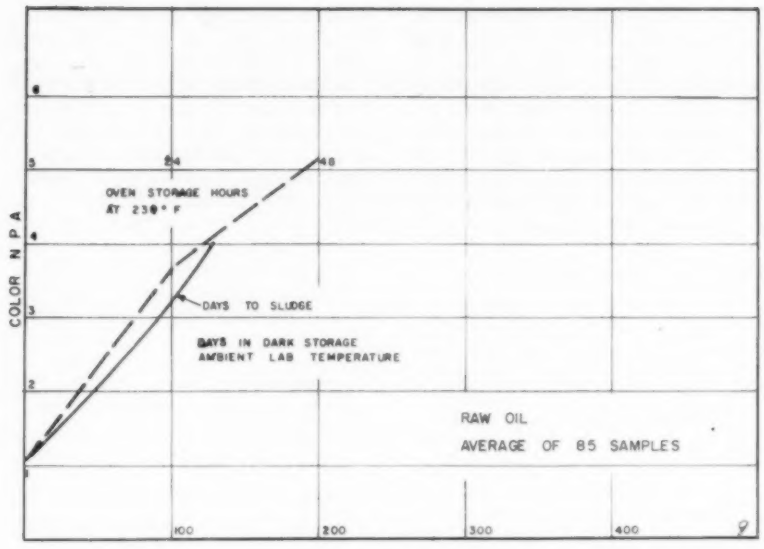


FIG. 2. Accelerated aging of untreated oil — NPA color vs oven temperature.

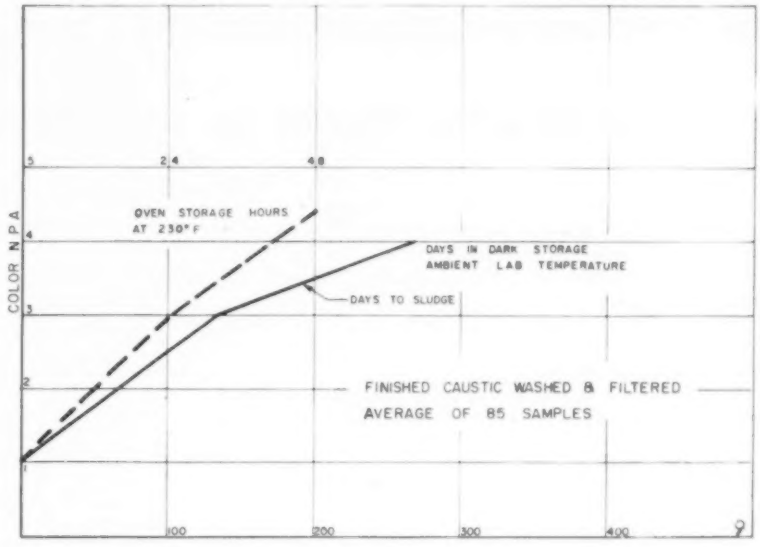


FIG. 3. Accelerated aging of treated oil — NPA color vs oven temperature.

pounds. Thompson and co-workers identified the trouble-makers as mainly polysulfides, thiophenols and pyrrols.[3,4] Contamination by heavy metals, particularly copper, may also be a significant factor in fuel oil deterioration as less than 0.1 ppm of this element can do harm.

Analysis of Clark furnace oil for objectionable constituents before and after plant washing with concentrated caustic soda solution gave the following results:

	Before Wash	After Wash
Phenols	0.36%	0.011%
Thiophenols	0.08%	0.002%
Pyrrols	120 ppm	120 ppm
Copper	0.02mg/liter	0.01mg/liter

The most significant change on caustic washing is the reduction in content of thiophenols. The pyrrol content is unchanged but, according to Offenhauer, Brennan and Miller,[2] these are not too troublesome in the absence of active sulfur compounds. The phenols, which are present initially in substantial concentration and are almost completely removed, are sludge formers according to these investigators, only if alpha naphthol is present. Copper content is sufficiently low to be innocuous.

Caustic Life

One problem in connection with this treating procedure was to determine the extent to which caustic solution could be used before replacement. An approximate figure of the free caustic remaining in solution was obtained by liberating water insoluble oil, largely phenols, by acidification of a measured sample of the caustic, calculating their

TABLE 2. Relation of Long and Short Storage Life to Plant Conditions.

	Days to color of 3	Days to color of 4	90% point	End Point	Catalyst-oil ratio	Vapor in	Temp out
Long storage	249	518	575	605	5.5	838	891
	267	518	584	625	5.2	837	890
	244	517	586	626	5.7	838	891
Short storage	80	169	586	626	6.7	831	908
	70	132	592	630	6.6	825	902
	73	162	590	628	6.5	827	908

TABLE 3. Effect of Caustic Use on Color Stability.

Caustic Solution									
Days used	°Be'	Phenols %	lb/bbl Free caustic	Color after oven, hr			Days in storage to color of		
				0	24	48	2	3	4
2	22.6	4	59.6	1.25	2.50	3.0	154	200	380
7	20.6	7	48.6	1.25	3.75	4.75	85	164	248
9	20.2	10	45.3	1.25	3.25	4.50	83	156	240
13	19.6	14	36.1	1.25	4.00	5.50	60	100	205
15	19.4	17	26.9	1.25	4.00	7.00	70	121	233
20	18.9	18	27.9	1.25	4.25	5.50	60	116	198
22	18.8	20	23.1	1.25	4.50	>8	60	91	196

caustic equivalent and by difference the amount of caustic left. The assumption was made that the liberated phenols had the same molecular weight as those removed in gasoline treating. Since they are undoubtedly of higher molecular weight, this introduces a safety factor as it will give a caustic figure on the low side.

The used caustic was titrated to phenol-phthalein and methyl orange end points. The phenols were liberated by cautiously adding an excess of hydrochloric acid to a 50 cc sample until the oil layer which separated no longer increased. Free caustic was then calculated by the formula.

$$(P - (M.O. - P) \times 1.4) - (\% \text{ Phenols}) =$$

Free caustic soda in lb per bbl
P = Phenolphthalein titration
M.O. = Methyl orange titration

Using this method, free caustic content of treating solution was correlated against oil stability as shown in Table 3. It was concluded that in summer the caustic should be renewed when it had reached a level of about 40 lb per bbl. During the winter months, when the temperature was low and the oil was not stored long in either the refinery or the customer's tanks, the caustic was used somewhat longer.

Blending Characteristics

Blends were made of catalytically cracked No. 2 furnace oil and other middle distillates produced in the same plant. Addition of doctor sweetened range oil increased the amount of sludge formed and considerably shortened the storage life. This was probably because the doctor treated oil contained polysulfides which, as mentioned earlier, are harmful to cracked middle oils. Practice of blending with doctor treated range oil was, therefore, forbidden. Addition of straight run diesel oil, a sweet product, either untreated or caustic washed, was advantageous as it made the oil more stable, gave it lighter color, and lowered the initial and 10 percent point. A considerable proportion of straight run diesel oil was blended with the No. 2 furnace oil before sale as a usual procedure. A thermally cracked No. 2 fraction produced from a high boiling catalytic side-cut, if caustic washed, also improved the stability of the catalytic No. 2 oil.

References

1. Bender, Diesel Fuel Conference, 1951, Bureau of Mines, Bartlesville, Oklahoma.
2. Offenbauer, Brennan and Miller, Petroleum Division Preprint General Papers, Atlantic City Meeting, American Chemical Society, 249.
3. Thompson, Chenicek, Druge and Symon, *Ind. Eng. Chem.*, 43, 935 (1951).
4. Thompson, Druge and Chenicek, *Ind. Eng. Chem.*, 41, 2715 (1949).

★ ★ ★

Premium Gasoline Octane Up 1.1 RON in 1957

GASOLINE on sale at service stations in December showed national weighted averages of 98.4 octane number for premium and 91.1 octane number for regular, according to the latest monthly survey of antiknock quality compiled by Ethyl Corporation.

Premium gasoline average was unchanged from November while regular gasoline average was 0.1 octane number higher than a month ago.

For 1957 as a whole, the premium average gained 1.1 octane number and the regular average gained 0.7 octane number.

Average tetraethyl lead contents in December were 2.51 ml per gal of premium gasoline and 2.02 ml per gal of regular gasoline.

Compared with the nationwide premium average of 98.4 octane number, nine cities reported premium averages of 99 octane number or higher. In regular gasoline, 17 cities showed average octane ratings of 91.5 octane number or higher compared with the national weighted average of 91.1 octane number.

For companies marketing more than one grade of premium, the survey showed a range of 100.3 to 102.3 octane number for the highest grade, on the basis of 38 samples in 19 cities.

Average Research Octane Numbers.

	Premium Gasoline			Regular Gasoline		
	Dec. 1957	Nov. 1957	Dec. 1956	Dec. 1957	Nov. 1957	Dec. 1956
Albuquerque, N. M.	97.9	98.0	96.5	88.2	88.2	86.9
Amarillo, Texas	98.3	98.1	97.0	89.2	89.2	89.0
Atlanta, Georgia	98.6	98.6	98.0	90.0	89.8	89.5
Bakersfield, Calif	97.5	97.4	96.5	87.8	87.9	86.3
Baltimore, Md.	99.4	99.0	97.8	92.7	92.6	92.4
Billings, Montana	96.0	95.9	94.4	89.2	88.9	87.4
Birmingham, Ala.	98.5	98.6	97.9	90.0	90.0	89.9
Boston, Mass.	99.2	99.3	98.2	93.4	93.2	92.7
Buffalo, N. Y.	99.3	99.3	97.7	93.1	93.0	92.2
Casper, Wyoming	95.8	95.9	94.3	87.8	87.6	86.1
Central Michgian	98.8	98.5	96.9	92.4	92.0	91.1
Charlotte, N. C.	98.9	98.9	98.0	89.9	90.0	89.8
Chicago, Illinois	98.4	98.2	97.3	91.4	91.6	91.3
Cincinnati, Ohio	98.6	98.6	98.0	92.2	91.9	91.3
Cleveland, Ohio	98.8	98.9	97.9	92.4	92.3	92.0
Corpus Christi, Tex.	98.4	98.6	98.3	90.1	89.9	89.4
Dallas—Ft. Worth Texas	98.4	98.4	98.0	89.8	89.6	89.6
Davenport, Iowa	98.5	98.6	95.8	90.5	90.3	83.0
Denver, Colorado	95.2	95.3	93.8	85.8	86.5	85.7
Des Moines, Iowa	98.3	98.6	96.2	89.2	89.1	89.3
Detroit, Michigan	98.9	98.9	97.2	92.6	92.3	91.7
El Paso, Texas	97.8	98.1	96.8	88.4	88.7	86.6
Fargo, N. D.	98.2	98.2	96.2	89.0	89.2	88.6
Hartford, Conn.	99.1	99.2	97.7	93.3	93.3	92.6
Houston, Texas	98.3	98.6	97.6	89.9	89.8	89.6
Indianapolis, Ind.	98.9	98.9	97.2	92.4	92.4	91.4
Jackson, Miss.	97.7	98.0	97.5	89.6	89.5	98.9
Jacksonville, Florida	98.1	98.4	97.8	91.1	91.0	91.4
Kansas City, Mo.	98.4	98.3	96.5	89.3	89.5	88.9
Little Rock, Ark.	98.9	99.0	97.7	89.5	89.3	89.4
Los Angeles, Calif.	97.6	97.7	96.6	87.9	87.7	86.3
Louisville, Kentucky	98.9	98.5	97.3	91.2	91.1	90.0
Memphis, Tenn.	98.7	98.8	98.1	90.1	90.7	89.9
Midland, Texas	98.8	98.6	—	88.9	88.7	—
Milwaukee, Wis.	98.5	98.5	97.3	91.7	92.2	91.8
Minneapolis-St. Paul, Minnesota	98.3	98.5	96.4	89.5	89.6	88.4
Newark, N. J.	99.2	99.1	97.4	93.3	93.0	92.5
New Orleans, La.	98.1	98.3	97.9	89.6	89.7	89.7
New York, N. Y.	99.3	99.4	98.2	93.2	92.9	92.3
Northwest Pennsylvania	98.5	98.4	96.7	93.0	92.8	92.7
Oklahoma City, Okla.	98.1	98.3	96.2	89.2	89.4	88.4
Omaha, Nebraska	98.2	98.1	96.3	89.2	89.3	88.6
Philadelphia, Pa.	98.6	98.6	97.4	92.6	92.6	92.2
Phoenix, Ariz.	97.5	97.6	96.6	88.7	88.4	87.1
Pittsburgh, Pa.	99.0	99.0	97.2	93.0	92.9	92.8
Portland, Ore.	97.5	97.8	96.8	88.7	88.8	87.4
Richmond, Va.	99.0	99.1	97.5	92.4	92.4	91.8
Salt Lake City, Utah	94.4	94.4	94.1	84.7	84.4	83.2
San Antonio, Texas	97.9	98.4	97.7	89.4	89.4	89.0
San Francisco, Calif.	97.7	97.5	97.2	88.3	88.6	87.0
Seattle, Wash.	97.2	98.4	96.2	88.0	88.3	87.1
Shreveport, La.	98.2	98.5	97.7	89.6	89.6	89.6
Spokane, Wash.	97.4	97.4	96.3	88.3	87.9	86.8
St. Louis, Mo.	98.2	98.4	96.4	91.0	91.4	89.7
Toledo, Ohio	99.3	99.4	98.0	92.5	92.4	91.8
Tulsa, Okla.	98.3	98.4	96.2	89.4	89.5	89.0
Wichita, Kansas	98.4	98.1	96.4	88.9	89.0	88.7

Economics of Refining in the PENN GRADE CRUDE AREA

Penn Grade area refiners face many problems similar to those of other "field" refiners, some special headaches, too. High crude cost and low production especially are pinching profit margins

John J. Schanz, Jr.*
and
Robert C. Barwick**

THE birthplace of the American oil producing and refining industry in western Pennsylvania will soon reach its one hundredth year of continuous operation. Though operations in the famous "Pennsylvania Grade" area continue to decline, they still offer an interesting study in field refinery economics.

Pennsylvania ranks fourth in the nation in refinery capacity. However, the greater part of this capacity is concentrated in the four large refineries located in the Philadelphia district which process foreign and Gulf Coast crude. The Penn Grade area, on the other hand, has 12 small field refineries that process only Pennsylvania Grade crude oil. Nine of these refineries are located in western Pennsylvania, two in West Virginia, one in New York State. Though the economics of the Penn Grade refineries are influenced by the special characteristics of the crude processed, in general they are typical of field refineries.

FIG. 1. Refineries in the Penn Grade crude area are located in western New York, Pennsylvania, and West Virginia.

History of the Penn Grade Area

Though some experimental refining of petroleum was done in Pennsylvania by Sam Kier in 1855, the discovery of a method for extracting kerosine from crude oil and the drilling of the Drake well preceded the development of regular refineries. The first refinery designed and built to extract kerosine from crude oil went on stream in January, 1861, and was located in the vicinity of the Drake well. This refinery was followed by a rash of small processing plants along Oil Creek and the Allegheny River. By 1863, there were 61 small refineries in the area processing from 15 to 300 bbl per day.

The area producing Pennsylvania Grade crude oil gradually expanded until it now embraces western Pennsylvania, southwestern New York State, eastern Ohio, and northwestern West Virginia. The petroleum produced in this region is a naturally occurring oil, which, without refining, closely approximates our modern motor oils. Its weight is very light with an API (Baume) gravity of from 40 to 45 deg. The crude is a paraffin base and con-

*Associate Professor of Mineral Economics, The Pennsylvania State University.
**Formerly Chief, Division of Minerals, Department of Forests and Waters, Commonwealth of Pennsylvania, now associated with New York State Natural Gas Company.

FIG. 2. Largest of the western Pennsylvania refineries is the 10,000 BPSD Pennzoil plant at Rouseville. It is a fully-integrated refinery, includes catalytic cracking, catalytic reforming, hydrotreating, and lube oil manufacture.
— Courtesy Pennzoil Company

FIG. 3. Sinclair's Wellsville, New York, refinery can process 8400 BPSD of crude, produce 2500 BPD of lube oils.
— Courtesy Sinclair Refining Company

tains virtually no aromatics, sulfur, or asphaltic material. It also has a very low natural viscosity. Its exceptional quality is known widely and has led to a substantially higher price at the well than that of any other type of crude oil.

Production of Pennsylvania Grade crude oil reached a peak through primary methods in 1891 and a second, lower peak in 1937 using secondary recovery. Production has declined steadily in recent years and was 8,237,000 bbl in 1956. The entire area operates on a stripping basis and only averages 0.29 bbl of crude per well per day. Proved reserves of Pennsylvania Grade crude oil are adequate to maintain production at approximately present levels for a number of years. However, since production is from controllable, artificial drive, the output depends on current demand and price. The economic situation of the Pennsylvania Grade crude oil producer and refiner may as a result lead to production levels below the maximum potential.

Penn Grade Area Refineries

In almost all cases Penn Grade refineries are modernized consolidations of the original refineries built in the early days and therefore are located at, or near, the fields. As of January 1, 1957, there were 12 plants operating in the western region. This number included nine in Pennsylvania, two in West Virginia, and one in New York. However, this number is more subject to change than is the case with the large refineries located along the East Coast, e.g. four Western Pennsylvania refineries have discontinued refining crude since 1950.

Penn Grade Refineries, January 1, 1957

Refinery	Company	Crude Capacity BPSD
Bradford, Pa.,	Kendall Refining Co.	5,200
Emlenton, Pa.,	Quaker State Oil Ref. Co.	3,000
Farmer's Valley, Pa.,	Quaker St. Ref. Co.	4,500
Franklin, Pa.,	Sonneborn, L. & Sons	2,000
Freedom, Pa.,	Ashland Oil & Ref. Co.	6,000
Karns City, Pa.,	Pennsylvania Ref. Co.	1,500
Reno, Pa.,	Wolf's Head Ref. Co.	2,600
Rouseville, Pa.,	Pennzoil Co.	10,000
Warren, Pa.,	United Ref. Co.	8,500
Falling Rock, W. Va.,	Elk Ref. Co.	4,500
St. Mary's, W. Va.,	Quaker State Oil Ref. Co.	2,800
Wellsville, New York,	Sinclair Ref. Co.	8,400
Total B/Day		58,600

Refinery Operation

The small crude oil refineries in the Penn Grade area, with only one exception, obtain all of their crude oil from the surrounding area where Pennsylvania Grade crude oil is produced. Almost all of these refining companies operate their own producing sites, usually within a short distance of the plant. The high cost of the crude makes it necessary to avoid extensive transportation of the crude if its refining is to be economically feasible.

In the Penn Grade area, the pipe line, as the cheapest means to transport crude overland, is used to gather 97 per cent of the total crude moved to refineries in the western area. As an example of the scope of pipe line operations by these small companies the largest system actually owned and operated by any one of the refining companies consists of 620 miles of gathering lines. The next largest system has 124 miles of lines and the other company systems are even smaller. The three per cent of crude not accounted for by the pipe lines is handled by tank truck and barge.

The 60 or more refineries that were located in the Penn Grade area in the days of Edwin Drake have now diminished in number to only 12 which process crude oil. Almost without exception these are the same refineries that were built in the 1860 to 1880 period of expansion. Though they have been substantially enlarged and modernized, for the most part they are located on their original sites. Only one of these refineries is owned and operated by a "major" oil company.

Many of the companies that formerly refined Pennsylvania crude oil are still in existence as manufacturers of specialty products from partially refined petroleum fractions. One refiner that discontinued crude refining in the mid-1930's is now listed as a manufacturer of cosmetics and toilet preparations. Another refinery which stopped handling crude just before World War II now produces petrolatum. A refinery that was refining crude as recently as 1949 is currently manufacturing lubricants and petroleum sulfonates, but uses partially refined oils instead of crude.

Two of the present crude oil refiners are also listed as petrochemical producers: One producing petroleum resins and the other petroleum sulfonates. There are also chemical manufacturers operating in the region using petroleum fractions as raw materials, e.g. the Koppers Company at Oil City produces alkylated cresols.

Economic Aspects

Not only in Pennsylvania, but in any

TABLE 1. Details of Penn Grade Area Refinery Capacity; January 1, 1957.*

Company	Feed, BPSD							Production, BPSD	
	Crude cap.	Vacuum dist.	Thermal cracking	Catalytic cracking total feed	Catalytic reforming	Hydro-treating	Polymer-isation	Lubes	Asphalt
Ashland Oil & Refining Co. (Valvoline Oil Co. Division)	6,000	2100	—	—	—	—	—	1250	—
Elk Refining Co.	4,500	1500	1500[1]	—	1500	500	100	1200	—
Kendall Refining Co.	5,200	—	1400[4]	—	1500	1500	100	1200	—
Pennsylvania Refining Co.	1,500	600	—	—	—	—	—	400	—
Pennoil Co.	10,000	3500	1600[1]	3600	2900	3650	520	2500	—
Quaker State Oil Refining Co.									
Emlenton	3,000	1500	750[1]	—	1000	—	75	1700	—
	—	—	600[2]	—	—	—	—	—	—
Farmer's Valley	4,500	—	1350[1]	—	1500	—	100	2300	—
St. Mary's	2,800	—	750[1]	—	1000	—	75	600	—
	—	—	600[2]	—	—	—	—	—	—
Sinclair Refining Co.	8,400	3000	3000[1]	—	—	—	100	2500	300
			5000[2]						
L. Sonneborn Sons, Inc.	2,000	—	—	—	—	—	—	500	—
United Refining Co.	8,500	4500	—	—	2600	750	—	1000	500
Wolf's Head Oil Refining Co., Inc.	2,600	—	—	920	—	—	—	750	—

[1] Gas oil cracking [2] Visbreaking [3] Naphtha reforming [4] Batch coking

*Oil and Gas Journal, Vol. 55, No. 12.

area where there is crude oil production, there are at least a few, relatively small, refineries. Their size is characteristically smaller than that of coastal plants such as those at Philadelphia. This size difference can be explained simply by the nature of the locations themselves. The coastal refineries are normally located in large marketing areas and receive crude from large foreign sources or a number of inland domestic fields. These coastal locations lead to stability either through the large marketing area they serve or through the collective production of a number of fields.

Oppositely, the field refinery is in a rather unstable position by virtue of the fact that when the field at which it is located becomes depleted, the plant may no longer be economical, or even necessary. The field site, then, is understandably undesirable for large capital expenditures on large refineries. Furthermore, oil fields are located where you find them, not necessarily near a good marketing area. If production is, or will be, limited and there is no large market nearby, no company will risk large amounts of capital; nor is there any reason for them to do so.

This is the situation in the Penn Grade area. Production from Pennsylvania fields has never been really large, nor do they have any particular advantage with respect to large markets nearby. The present refineries in the Penn Grade area have an average capacity of 4900 bbl per stream day of crude capacity and cost nearly $6,500,000. The size range is from 1500 to 10,000 bbl per day. About 200 workers are employed at each refinery, the number varying directly with the size of the particular installation.

Processing Facilities

A typical Penn Grade refinery will have the following major components: An atmospheric crude still for Pennsylvania Grade crude oil, filter press dewaxing and bauxite adsorption filtering for waxes, centrifuge dewaxing for petrolatum, a visbreaker for reduction of residue, asphalt oxidizing equipment, a catalytic reforming plant for high octane gasoline, a catalytic hydrogenation plant for upgrading middle distillates to specialities, and plant utility and maintenance facilities.

Only two of the Penn Grade refineries have modern fluid catalytic cracking facilities. Until recently these small refineries could not afford the expense of changing from the thermal cracking process. However, a new, small fluid type cracker has been developed that may make it possible for these refineries to convert to the newer process.

The position of the Pennsylvania Grade crude oil refiner is slightly different than that of the usual small refining company located at the production site. His size, operating costs, transportation, and location are the same as other small refineries. The difference is found in the type of petroleum being processed

The Penn Grade refiner is confronted by an advantage in quality of crude and a disadvantage in price. He receives an internationally known, high quality crude oil; but, at the same time, he has the disadvantage of operating with small quantities of a very costly crude. Pennsylvania Grade crude from the Bradford field was $4.65 per barrel in December 1957; a formidable factor to overcome during refining and still obtain a profit from the operation. This has resulted in a 50 percent decrease in the Penn Grade refiner's margin between the cost of crude and his sales realization in the past 30 years.

Since Pennsylvania Grade crude oil is more expensive and the refiner's margin small, the refiner must make some adjustments during manufacturing that will lower his overall costs. This is done partially by reducing offsite facilities to a minimum. This alone is not enough, so specialization is relied upon. If the refiner limits his output to one or two products that have a high sales value, he can key all his efforts to these products as far as packaging, technology, and marketing are concerned. Other products become secondary and are important only as supplementary sources of income.

The Pennsylvania Grade refiner by specializing in motor oils and lubricants has concentrated his efforts on the production, long distance transportation, and advertising of these products. In doing this he has reduced the costs involved in these phases of the industry while developing an established name and market. The one great danger in this type of specialization occurs when other companies also begin to emphasize the same special products. There is a good possibility that the specialist will then lose a substantial part of his total market without an established alternate product which can be used to minimize the effect of the loss.

Product Distribution and Markets

While transportation of Pennsylvania Grade crude oil is almost entirely by pipe line, product movement by this method amounts to less than one per cent of the total. The production of gasoline and other bulk products by the refineries is too small to warrant construction of pipe lines.

The methods used for transportation are railroad and tank truck. The railroad handles on the average 60 per cent of the total product transportation. Box cars carry packaged products, such as motor oils, greases, oil additives, and special lubricants to every part of the United States and to coastal ports for overseas shipment. Tank cars are used to transport gasoline and fuel oil to areas of concentrated population that are within the economic radius of distribution of these products.

The bulk of the gasoline and fuel oils are marketed within a radius of 150 miles through either company owned, or affiliated, service stations or by unbranded sales on the open market. The three companies using their own brand names market gasoline in western Pennsylvania, western New York, eastern Ohio, and West Virginia. They are virtually unknown beyond this area. Lubricants and motor oils, however, are sold by the companies in every state of the United States, all of the United States' possessions, Canada, Mexico, the Caribbean area, and at least 17 other foreign countries.

An interesting facet to the worldwide distribution of Pennsylvania Grade motor oils and lubricants is that, with the exception of the relatively few company service stations, all marketing is done through independent service

stations, automotive dealers, oil jobbers, specialty jobbers, and garages. Only one chain of service stations owned, or controlled, by a "major" company markets Pennsylvania Grade motor oil on a regular basis in addition to its own motor oils.

Recent sales promotion by the large companies on the basis of oil additives and detergents is a threatening situation to the Pennsylvania Grade refiner. It is an established fact that motor oils and lubricants provide a higher unit value and profit than gasoline. If the major companies can increase their sales of these products, their total operation can be more profitable. The resulting growth in emphasis on the sale of lubricants by the major companies threatens the Pennsylvania Grade refiner with greater competition than previously and could cause a loss, at least in part, of his market and drastically reduce his operations.

Conclusions

Though field refineries will probably become larger and more numerous in the future because multiple products pipe lines will make possible cheap overland transportation of products, the spread of this trend to the Penn Grade area is unlikely unless new oil fields are discovered. So long as the refineries are dependent on a declining and small supply of paraffin base crude there will not be sufficient volume of bulk products, such as gasoline, to justify large refineries and products pipelines. The Penn Grade refiner will have to remain a small specialty refiner whose chief product, motor oil, is more adaptable to small container packaging at the refinery and to railroad shipment.

In addition to being unable to capitalize on the economy of a larger size refinery and more efficient transportation methods, the Penn Grade refiner is faced with the problem of processing a high cost crude oil. This can be compensated for, at least in part, by the low cost of transporting the crude for only short distances to the refinery. However, the costs involved in the actual refining are much greater per unit of crude processed. The Pennsylvania Grade refiner has a superior quality raw material with which to work; but, because of its relatively short supply and the small scale of the operation, it is impossible to gain the advantages of mass production and resulting low unit costs realized by the large refineries.

Consequently, the refiner in the Penn Grade area produces lubricating oils as his principal product because of the quality of the crude and the additional profit to be made through the sales of these products. Strictly speaking he is not actually in competition with the large integrated companies, but rather supplements their production of lubricants.

The small Pennsylvania Grade crude oil refiner is faced with several serious threats to his future prosperity. The supply of Pennsylvania Grade crude is always in a sensitive position being dependent upon stripper production and a premium price structure. The percentage share of total products markets held by lubricants has been declining as better lubricants and motors have decreased the amount of lubrication required per engine. Competition is increasing from major companies who are putting greater emphasis on the quality and sales of their lubricants through the highly publicized development of improved motor oils containing detergents and other additives.

There are possible solutions to the problem of the Pennsylvania Grade refiner, however. Advances in technology can assure continued production of limited quantities of Pennsylvania Grade crude oil. Though the per engine consumption of lubricants is declining, the total demand for high quality lubricants should continue to increase. Finally, increased competition can be met by continued improvements in Pennsylvania Grade lubricants that will be sufficient for them to maintain their preferred position on the markets. * * *

Esso Reduces Manpower at Bayonne Refinery

As a further step in streamlining operations, Esso Standard Oil Company laid off about 700 employees on January 17 at its Bayonne, New Jersey, refinery. This is the fourth major manpower reduction made by Esso within the year: Two separate layoffs at the Bayway, New Jersey, refinery were made in 1957, effecting a total of about 1700 people, and the company shut down all but asphalt and terminalling operations at it's 60,000 bbl per day Baltimore, Maryland, refinery.

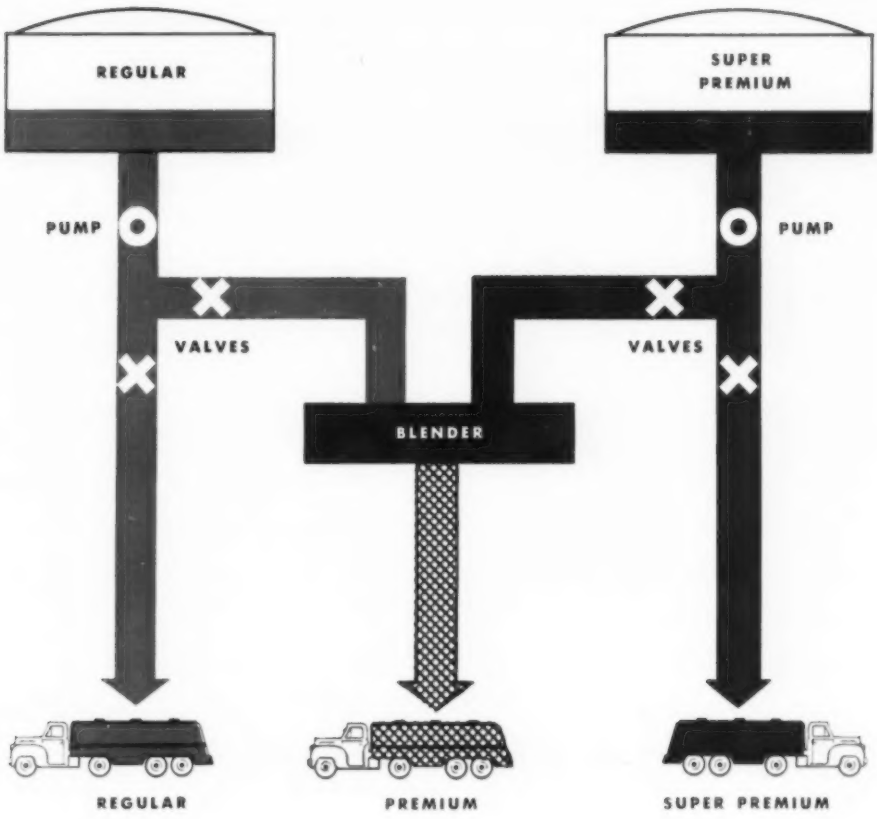
Most of the men terminated at Bayonne were maintenance and construction workers, according to the company's report. Esso said that various plant improvement projects had been completed to the point where only a third of the total employees were engaged in actual operations, the balance having been used in the rebuilding program.

Suprvisory requirements have been reduced by virtue of the layoff and Esso plans to retire, effective March 1, those who are over 55 years of age. Supplements to normal retirement income will be provided to this group.

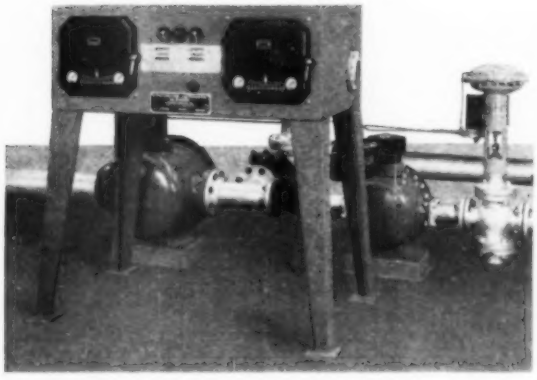
Bayonne refinery is a specialty plant, engaged in terminalling for the storage, packaging and delivery of products made at other company plants, and manufacture of waxes, asphalts, and lube oil additives.

During the past year new wax storage and loading facilities have been completed, thus consolidating those operations. New blending equipment for bulk lubricants has been put into service, and many small, scattered tanks were replaced by large storage tanks. And, the company says that process operations have been considerably streamlined to reduce operating and maintenance costs.

"Hey, Ed—here's the guy who's been siphoning gas out of company cars for the last 15 years!"



stock TWO, sell THREE!



Are you committed to two premium motor fuels? Capitalize on current market demands for higher octanes to augment present regular and premium grades. Offer these super premium grades *without costly additional tankage!*

How? Store only regular and super premium grades at your terminal . . . install a Proportioneers TC Blender (available immediately) . . . and be able to supply these and any intermediate grade simultaneously. The TC Blender provides accurate, flexible in-line blending directly from component storage to tank truck, tank car, or barge.

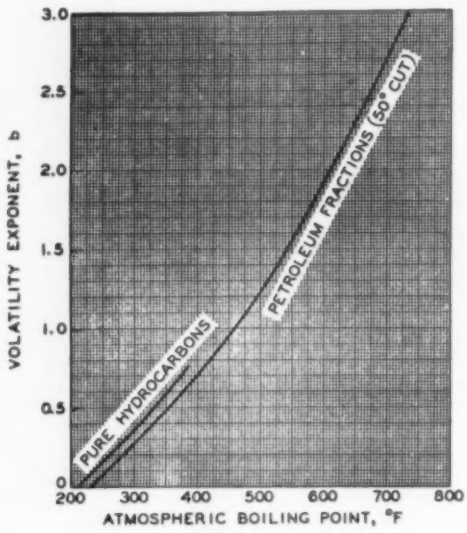
Whatever the market octane demand, make your operation flexible enough to meet it!

PROPORTIONEERS
DIVISION OF
B-I-F INDUSTRIES
B-I-F METERS FEEDERS CONTROLS

B-I-F sales engineers will gladly provide you with complete data. Write Proportioneers, Inc., 442 Harris Ave., Providence 1, Rhode Island.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS SEE READER SERVICE CARD

Vapor/Liquid Equilibrium Constants for Hydrocarbons



This month's Continuous Tables feature concludes the series on Vapor/Liquid Equilibrium Constants. Part I was a supplement to the December 1957 issue and Part II on pages C-51 and C-52 in the January 1958 issue.

(Figure 4)

VOLATILITY EXPONENT

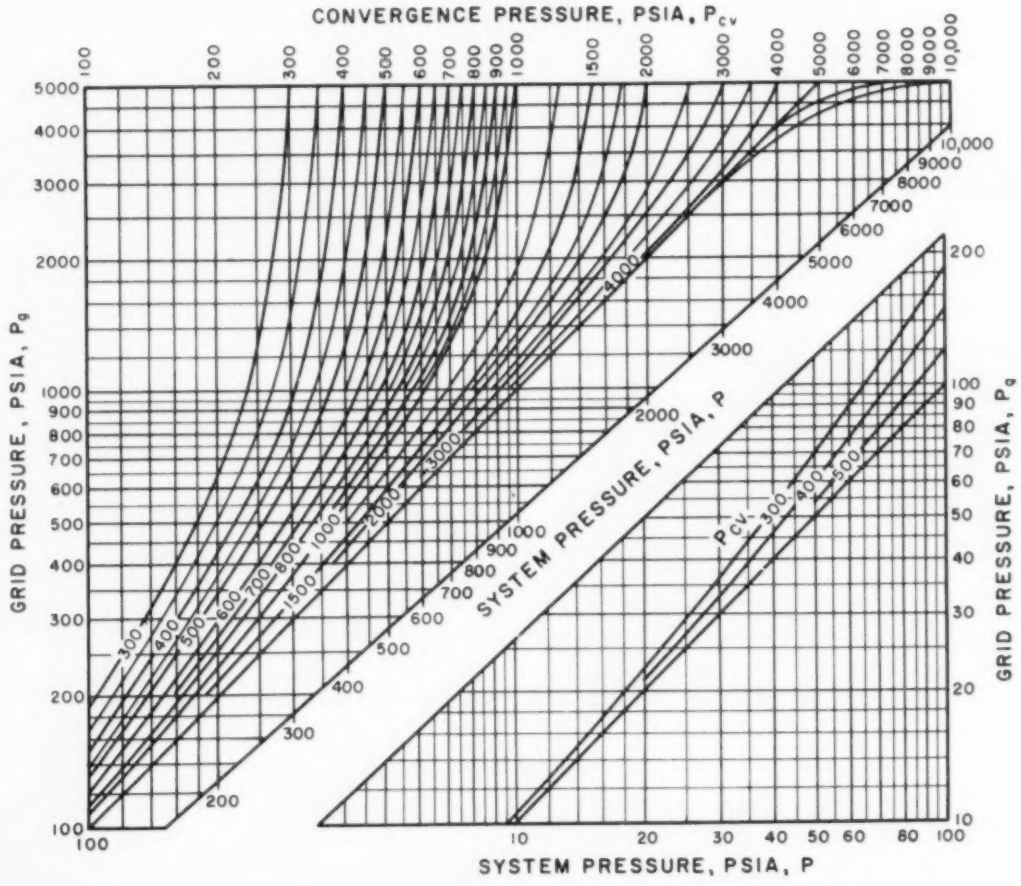
$$K_{pf} = K_7 \left(\frac{K_7}{K_2}\right)^b ; K_{pf} = \text{K value of pet. fract.}$$

K_2 = K value ethane; K_7 = K value heptane

b = Volatility exponent

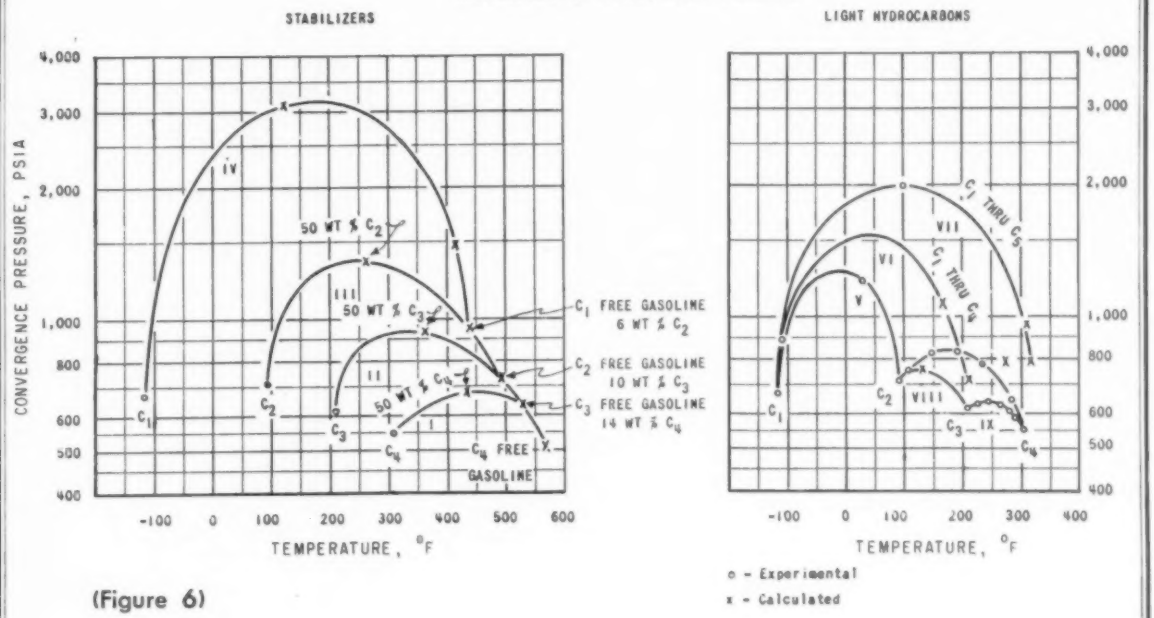
(Figure 5)

GRID PRESSURE RELATIONSHIP



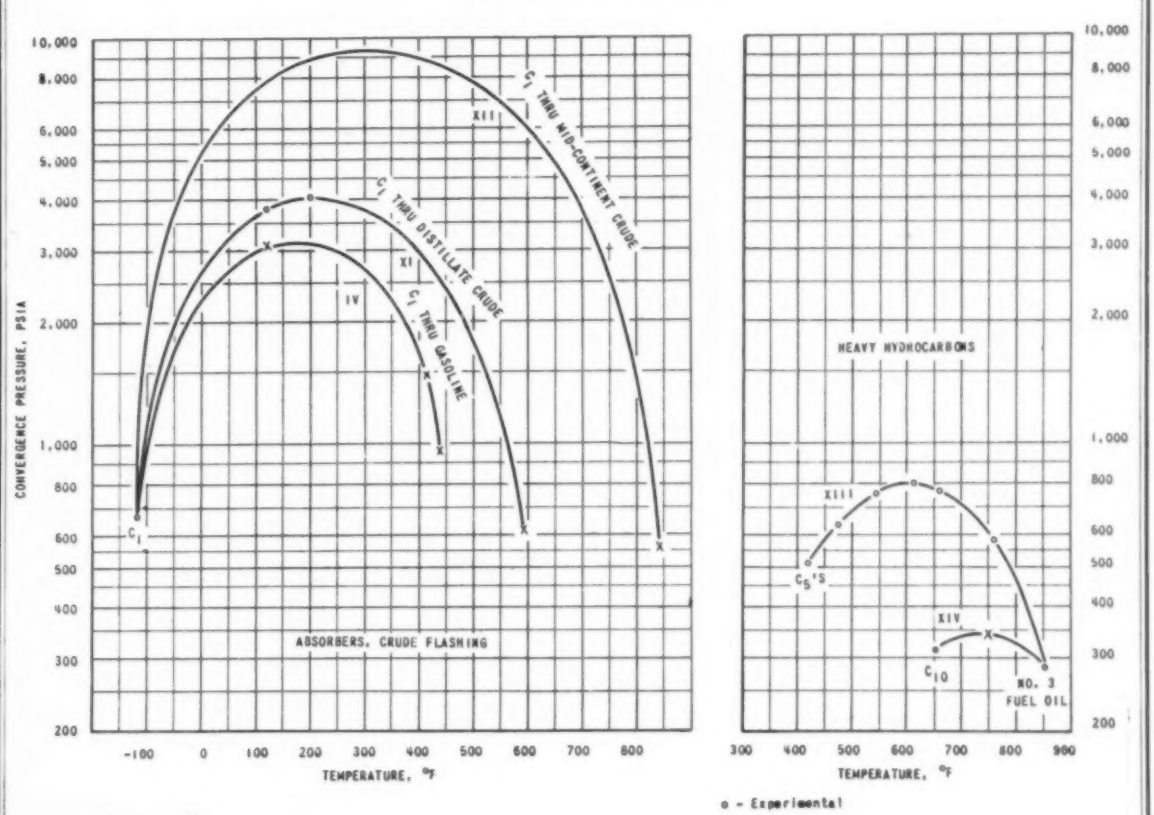
Vapor/Liquid Equilibrium Constants for Hydrocarbons

CRITICAL LOCI OF TYPICAL REFINERY MIXTURES



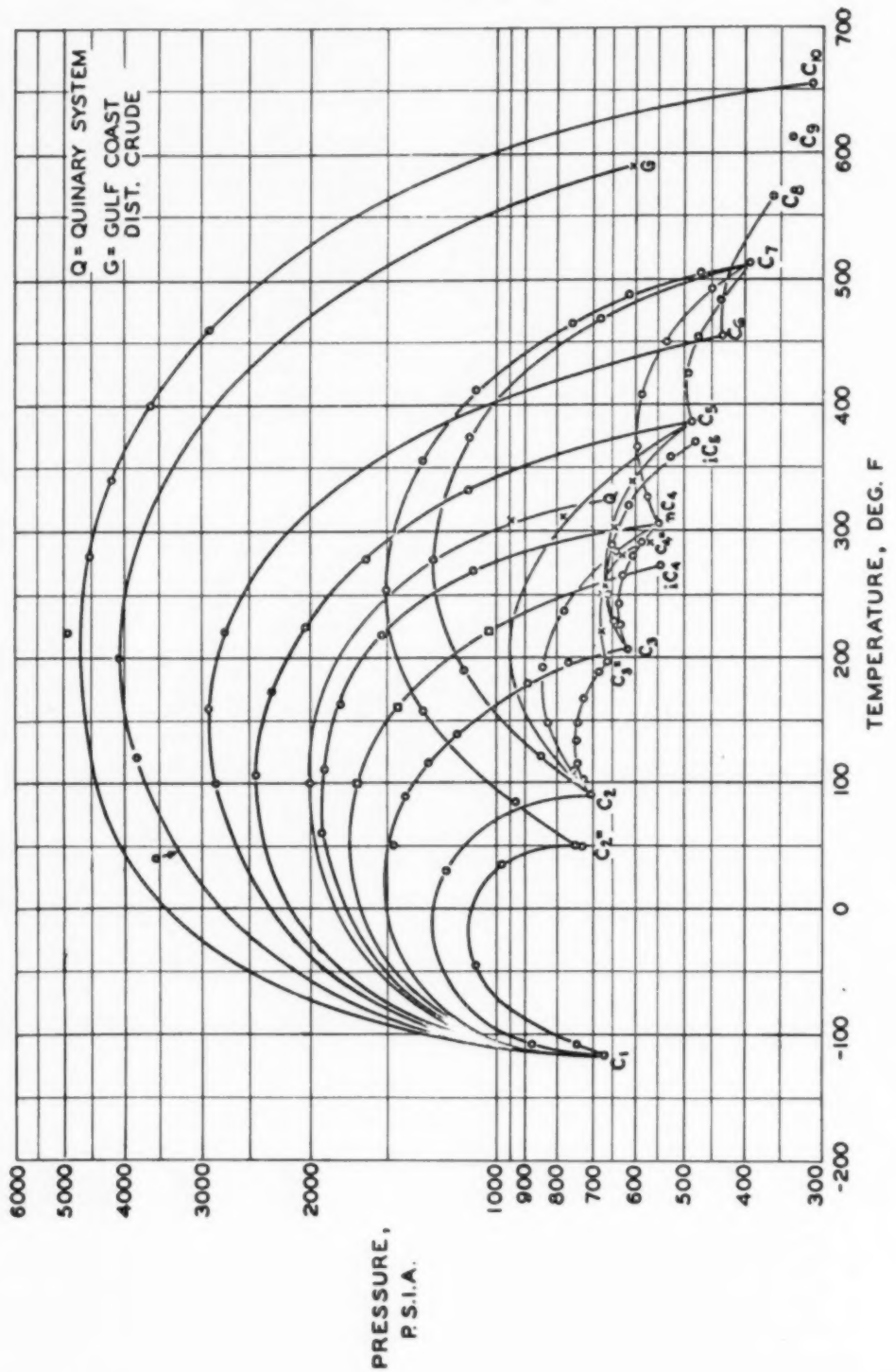
(Figure 6)

CRITICAL LOCI OF TYPICAL REFINERY MIXTURES



(Figure 7)

Vapor/Liquid Equilibrium Constants for Hydrocarbons



(Figure 8)

Vapor/Liquid Equilibrium Constants for Hydrocarbons

Table 1. Typical Applications of Convergence Pressure Curves in Fig. 6 and 7.

Fig. 6.

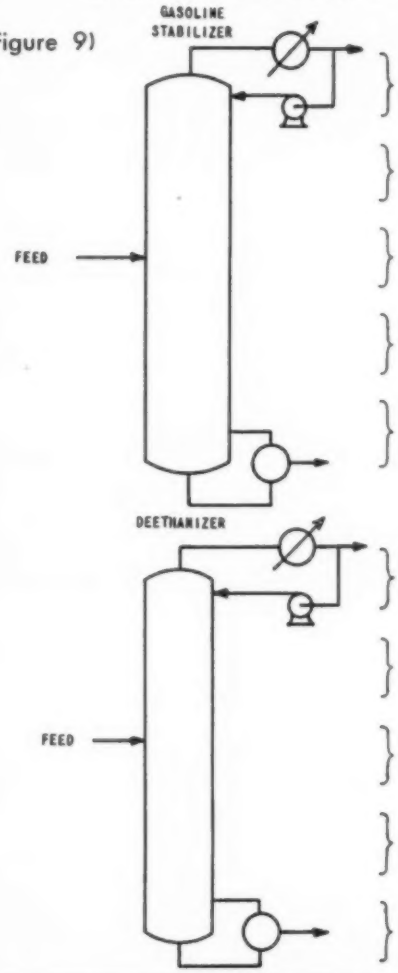
Curve	*Composition*	*Typical Applications*
I	C_4 thru 400 EP Gasoline	Reboiler and bottom plates of stabilizer
II	C_3 thru 400 EP Gasoline	Mid-stripping section of stabilizer
III	C_2 thru 400 EP Gasoline	Top-stripping section of stabilizer
IV	C_1 thru 400 EP Gasoline	Stabilizer feed plate; top of bubble tower
V	$C_1 - C_2$	De-ethanizer overhead
VI	$C_1 - C_2 - C_3 - C_4$	Top rectifying section of stabilizer
VII	$C_1 - C_2 - C_3 - C_4 - C_5$	Top rectifying section of depentanizer
VIII	$C_2 - C_3$	Top rectifying section of de-ethanizer
IX	$C_3 - C_4$	Reboiler and stripping section of butane-propane de-ethanizer
X	$C_2 - C_4$	In conjunction with Curve X for feed plate of butane-propane de-ethanizer

Fig. 7

XI	C_1 thru distillate crude	Light crude flashing; adsorber (light lean oil)
XII	C_1 thru Mid-Continent crude	Mid-Continent crude flashing; adsorber (heavy lean oil)
XIII	C_5's thru No. 3 fuel oil	Bubble tower bottoms
XIV	C_{10} thru No. 3 fuel oil	Bubble tower bottoms

EXAMPLE APPLICATION OF CONVERGENCE PRESSURE CURVES IN FIGURE 6

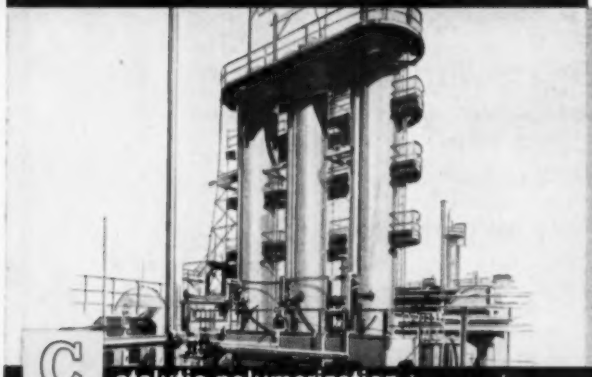
(Figure 9)



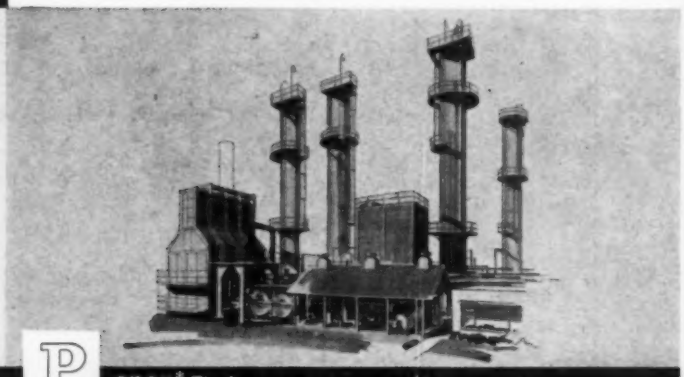
Range of Composition	Temperature, °F	Convergence Pressure PSIA	Figure 2 Curve Number
$C_1 - C_4$	100	1400	VI
$C_1 - C_5$	175	1850	VII
C_1 – Gasoline	250	3000	IV
C_3 – Gasoline	300	930	II
C_4 – Gasoline	400	660	I
$C_1 - C_2$	100	800	V-VI
$C_1 - C_3$	140	900	V-VI
$C_1 - C_4$	170	1000	VI
$C_2 - C_3$	180	760	VIII-X
$C_3 - C_4$	220	620	IX

Somewhere on these pages is a UOP answer to most every petroleum processing problem.

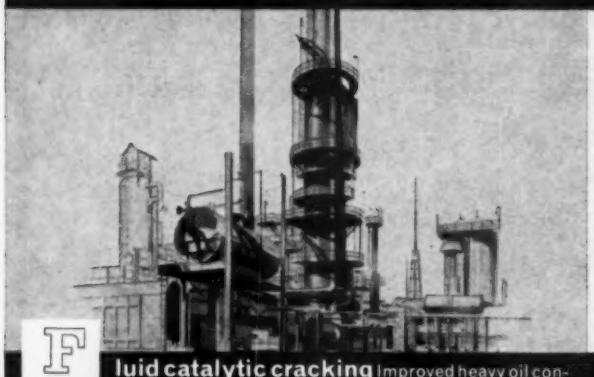
Working out the solution to a processing problem can be a pretty tough assignment for any refiner. But this is a UOP specialty and it's highly probable that UOP can come up with the right answer. Perhaps, we don't have all the answers right on tap but our more than 40 years of research and engineering development in oil refining technology is pretty good assurance that we can work them out. Quite possibly you will find



Catalytic polymerization A process for converting propylene and butylenes to high grade gasolines



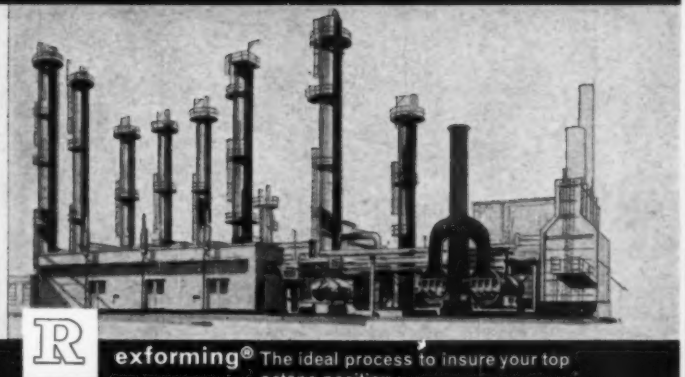
Penex* The first practical process for upgrading pentane and hexane fractions



Fluid catalytic cracking Improved heavy oil conversion process for higher yields and octane numbers

Vacuum distillation and visbreaking Efficient, economical processes for feed preparation

Low pressure coking A process that adds market flexibility

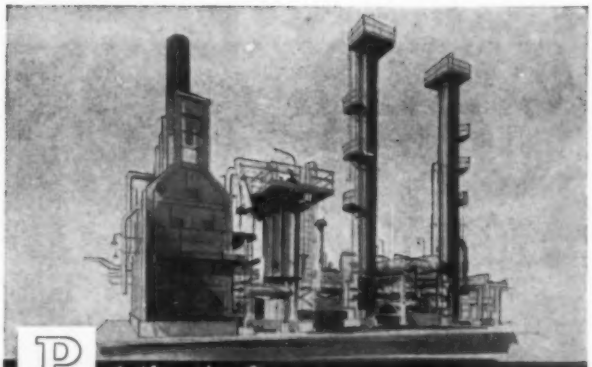


Rexforming® The ideal process to insure your top octane position

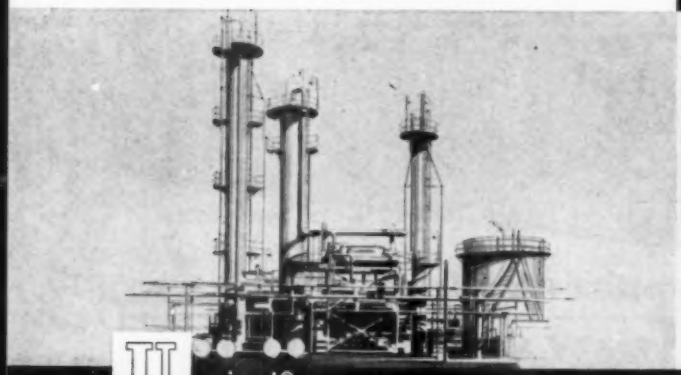
C-32

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

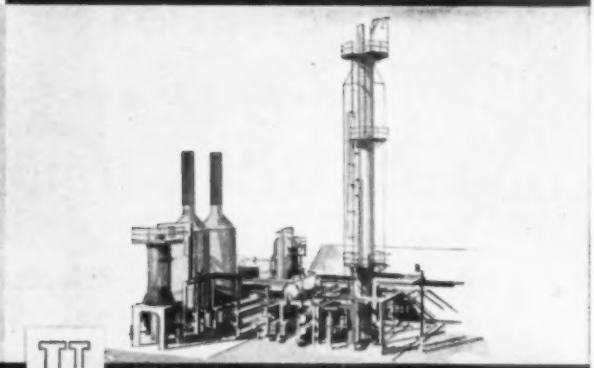
the solution among the processes shown here. For these represent only some of the refining and petrochemical processes UOP makes available to all refiners, anywhere. If you would like to know more about all the refining and petrochemical processes available from UOP we'll be glad to send you our handsome new 36 page brochure describing these more fully. Just drop us a line on your company letterhead.



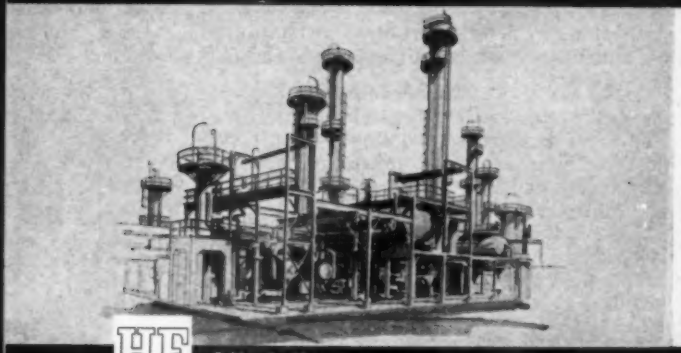
Platforming® The most popular process for upgrading gasolines



Unisol® A finishing process without octane degradation

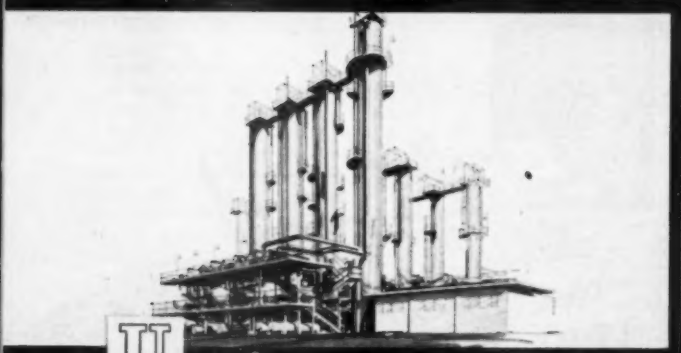


Unifining* A modern process for completely purifying petroleum distillates



HF Alkylation A catalytic process for producing alkylate

Thermal cracking An improved design of a basic refining process



Udex® A process for separating gasoline into high and low octane fractions

UOP® UNIVERSAL OIL PRODUCTS COMPANY

30 Algonquin Road
Des Plaines, Illinois, U.S.A.

MORE THAN FORTY YEARS OF LEADERSHIP IN PETROLEUM REFINING TECHNOLOGY

*Trademark

"I cut piping costs with

B&W Welding Fittings!"

"Minimum installation time and costs are my responsibility. The dimensional accuracy of B&W Welding Fittings permits quick and positive welding with no erection delays."

Cutting costs is everyone's responsibility. In a piping system, using welding fittings that align accurately is one sure way of saving time and money — in installation and in maintenance. The dimensional accuracy of welding fittings like this B&W Ell assures you of trouble-free fabrication and installation. Their true circularity, full radius, and walls of uniform thickness will enable you to make your piping dollars go farther. Write for bulletin FB504.

B&W Welding Fittings and Forged Steel Flanges are available in carbon steel and the B&W CROLOYS.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION • FITTINGS DEPARTMENT
3839 WEST BURNHAM STREET • MILWAUKEE 46, WISCONSIN

THE *NATURAL* SOURCE FOR ALLOY FITTINGS B&W TUBULAR PRODUCTS DIVISION

FA-8904-FE2

Seamless welding fittings and forged steel flanges, seamless and welded tubular products, solid extrusions — in carbon, alloy, stainless steels and special metals

DU PONT Petroleum Chemicals NEWS

Number 84 in a Series of Bulletins for the Petroleum Industry FEBRUARY 1958

A STORY OF MEN AND EQUIPMENT

Turning DuPont's automotive research into service for refiners

COLOR...
boon to petroleum merchandising

DuPont, a leader in the research and manufacture of dyes since 1916, has developed brilliant, appealing colors for petroleum products.

Since the 1920's dyes have been used in gasoline to indicate TEL content. In later years refiners have become increasingly color conscious. Today, dyes are used in all types of petroleum products – kerosine, home-heating oils, tractor and diesel fuels, and lubricating oils and greases.

Merchandising value

The trend toward increased use of colors in petroleum products has been due largely to industry appreciation of its merchandising value.

In products other than gasoline, brand identification through the use of color can provide an important competitive selling advantage. This has been ably demonstrated by a number of motor oil and grease marketers.

Now, heating oil and diesel fuel suppliers are becoming increasingly interested in the merchandising value of petroleum dyes. The current interest in "premium" heating and diesel fuels seems to be apparently increasing the demand for merchandisable color.

A secondary but extremely practical reason to use petroleum dyes is leak detection. Color quickly points out wherever a leak occurs, making quick repair possible. Hence color in this use can greatly reduce loss of product and, at the same time, promote safety, protecting personnel against fumes, and property against the hazards of fire.

Let us help you

In addition to oil-soluble dyes for petroleum products, DuPont's over-all experience in the world of color covers a uniquely broad range of product categories – textiles, paints, colored plastics, photographic film, and basic pigments manufacture, to mention a few. And we are prepared to offer you the most comprehensive color assistance available in the additives field.

To take advantage of this assistance, you are invited to discuss your color selection and technical dyeing problems with one of our Petroleum Chemicals Division representatives.

by R. O. Bender

Adapting your fuels to satisfy the growing octane appetite of modern high compression ratio engines involves a rapidly changing technology. As a leading supplier of tetraethyl lead and other additives for petroleum products, the DuPont Petroleum Chemicals Division provides a wide range of services to help you keep pace with these constantly advancing fuel requirements.

PAUL RICHARD is a DuPont Petroleum Chemicals Division automotive liaison man in Detroit. He acts as a sort of "clearing house" for technical information of interest to both the petroleum and automotive industries.

Behind these services are the research experience and know-how of scores of DuPont chemists and engineers; the extensive facilities of the DuPont Petroleum Laboratories; and our continuing liaison work with the automotive industry. All these combined help us produce technical information that helps to bridge the gap between the automotive and refining industries.

Although most of our combustion chamber and other automotive research

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

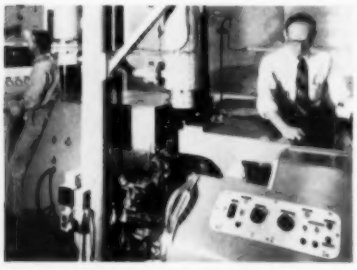
DUPONT *Petroleum Chemicals* NEWS

CONTINUED *Research Services*

activity centers around the DuPont Petroleum Laboratory in Deepwater, N. J., an important part of our investigations has its roots in the automotive plants in Detroit. Paul Richard and Donald Diggs keep in close touch with new automotive engine developments. They study compression ratio trends as well as other design factors which may affect the quality of fuel the new engines will need. Their information is used at the Petroleum Laboratory to build or modify the future type engines in which fuel performance is studied. Between this close automotive industry liaison and the Laboratory's own investigations, our Petroleum Chemicals Division is able to offer the refining industry research information of timely interest and value.

Unique equipment used

To develop and tailor this information to your needs, the Petroleum Laboratory maintains a fleet of specially equipped and instrumented road test cars. These include advanced design, as well as current model engines. The electronics section of the Laboratory has developed also many unique instruments to study the mechanisms of knock and other abnormal combustion phenomena.



THIS SPECTROMETER is one example of the unusual equipment being used at the DuPont Petroleum Laboratory for studying the chemistry of knock and the fundamentals of combustion. A single-cylinder engine, which can be seen in the center of the picture, is used in conjunction with the spectrometer.

Varied specialties

The staff at the DuPont Petroleum Laboratory is unusually complete. It includes chemists, mathematicians, physicists, refinery and automotive technologists, engine and fuel rating specialists. There are also electrical engineers whose chief job is to develop instrumentation for measuring and recording transient phenomena. Together, these men make up a well coordinated research team with extensive training and experience in the field of combustion.

Results available

The research results developed by this team are made readily available to the whole refining industry. They are published periodically in papers presented to scientific organizations and industry technical associations.

Write us for more information about this program or published results of our automotive research work.

You ought to know...

ALFRED R. MULLIS is Assistant Director of Sales of the Petroleum Chemicals Division. Prior to this assignment, he was manager of the Division's Eastern Region with headquarters in New York.

Mr. Mullis joined the DuPont Company in 1947 as a sales representative in the Gulf Coast Region. He was appointed manager of this region in 1951 and transferred to New York the following year.

Mr. Mullis is a graduate in chemical engineering from Rice Institute. His first job was on the research and development staff of a large refining company. During World War II, Mr. Mullis spent four years in the Navy as a petroleum inspector for the Bureau of Ships.

When he was promoted by DuPont to Assistant Director of Sales, Mr. Mullis succeeded Mr. W. Sam Carpenter, III who became Director of Sales. Mullis's former position as manager of the Eastern Region was filled by Earl G. Bennett, formerly manager of the Central Region with Chicago headquarters. Mr. Bennett was succeeded by Donald W. Frison, formerly manager of the Mid-Continent Region, with headquarters in Tulsa.

HOW DuPont DMF Antistall Additive prevents carburetor-icing

When vaporizing in a carburetor, gasoline absorbs heat from its surroundings. This cools the metal parts of the carburetor and the water vapor in the air which is drawn into the carburetor.

This cooling process causes the moisture to condense and freeze when the atmospheric temperature is anywhere in the range from 22 to 55°F. – and when the relative humidity is 65% or more. Ice then forms in the carburetor causing the engine to stall from fuel starvation.

DuPont DMF protects the motorist against annoying stalls by preventing the formation of ice in carburetors. The DMF does this by lowering the freezing point of the condensed water in the carburetor to well below 32°F. This action is positive and unfailing.

SALES OFFICES

Chicago 3–8 So. Michigan Ave. RAndolph 6-8630
Cleveland 15–25 Prospect Ave. SUperior 1-1363
Denver 2–Petroleum Club Building, 16th & Broadway AComa 2-2347
Houston 2–705 Bank of Commerce Bldg. CApitol 5-1151
Los Angeles 17–612 So. Flower St. MAdison 5-1691
New York 20–1270 Ave. of the Americas COlumbus 5-2342
Philadelphia 2–3 Penn Center Plaza LOcust 8-3531
Pittsburgh 22–1 Gateway Center ATlantic 1-2933
San Francisco 4–111 Sutter St. EXbrook 2-6230
Seattle 3–4003 Aurora Ave. MElrose 6977
Tulsa 1–1811 So. Baltimore Ave. LUther 5-5578
In Canada–DuPont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**–Ontario HUdson 1-6461
In Other Countries–Organic Chemicals Department, Export Division, 7447 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962.

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living
... through Chemistry

See the "DUPONT SHOW OF THE MONTH" on CBS

DuPont Tetraethyl Lead and other Petroleum Additives

OVER

A-6048

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

Printed in U. S. A.

DESIGN HANDBOOK

How to Design Finned Tube Shell and Tube Heat Exchangers

	PART	
Fundamentals of Finned Tube Heat Transfer	1	• *Basic heat transfer relationships; example problems*
Design of Finned Tube Condensers	2	• *Selection and sizing of equipment for hydrocarbons and other organic compounds*
Design of Finned Tube Heaters and Coolers	3	• *Design relationships; liquid-liquid cooler sample problems; economics of finned tube exchangers*
▶ Design of Finned Tube Partial Condensers	4	• *Rigorous and approximate methods; how to design for saturated and superheated feeds*

Edwin H. Young
Dennis J. Ward

THE DESIGN OF CONDENSERS for the condensation of vapors from noncondensing gases is complicated by unusual conditions of heat transfer not encountered in total condenser design. In condensing part of the vapors in a gas stream, all of the properties of the gas stream vary greatly as the condensable vapor is removed. The heat-transfer coefficient of the gas film, the mass rate of gas flow, and the physical properties of the gas stream can change considerably as condensation proceeds. The condensation depends upon the diffusion of the vapor molecules through the gas mixture to the condensing surface. This involves two types of diffusion: (1) Molecular diffusion and (2) eddy diffusion. Molecular diffusion involves the movement of individual molecules of condensable vapor from the main bulk stream onto the condensate film under the influence of a concentration (partial pressure) gradient. Eddy diffusion is the movement of groups of molecules of the bulk stream by turbulent motion to the condensate surface. The main resistance to condensation now occurs between the bulk stream of vapor and the surface of the condensate. Therefore, mass-transfer coefficients must be considered as well as heat-transfer coefficients in the mechanism of condensation rate.

Calculation of Overall Heat Transfer Relationship

The usual overall heat transfer equation

$$Q = U_o A \Delta T_m \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

does not directly apply in this case since no method of calculating mean-temperature differences based upon terminal conditions is applicable. An accurate method of determining such a ΔT_m has long been sought. The usual logarithmic mean of the terminal temperature differences is inapplicable.

Overall heat-transfer coefficient varies widely from point to point in a partial condenser, being high where the condensing vapors are relatively concentrated and low in zones where most of the condensable vapor has been removed. Thus, no simple average heat-transfer coefficient is applicable.

The overall heat-transfer relationship for the heat transfer occurring in partial condensers must be written as:

$$dA = \frac{dq}{U \Delta t}$$

where:

$\Delta t = (t_c - t_w)$
t_c = condensate-gas interface temperature, F
t_w = water temperature, F
U = all resistances but the gas film (U comb. later on)

or

$$A = \int_o^q \frac{dq}{U \Delta t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

In general, it is not possible to integrate this relationship formally using analytical expressions for both U and Δt as functions of q.

The method of Colburn and Hougen[1] is generally accepted as the basis for obtaining rigorous design of cooler-condensers. The method is tedious since it involves successive trial and error substitutions. A number of approximation methods have been published by Cairns,[2] Bras,[3,4] Mickley,[5] and others.

Rate of transfer of sensible heat from the gas stream on the shell side of the exchanger to the outside of the tubes is given by:

$$\frac{dq_s}{dA} = h_o'(t_g - t_c) \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Rate of transfer of latent heat from the gas stream on the shell side of the exchanger to the fin side of the tubes due to mass transfer of condensible material to the tube surface is given by:

$$\frac{dq_L}{dA} = K_M(p_v - p_c) \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Total rate of heat transfer, given by the sum of Equations 3 and 4 must be transferred through the tube and water film:

$$\frac{q}{A} = h_o'(t_g - t_c) + K_M(p_v - p_c) = U_{comb.}(t_c - t_w) = U \Delta t$$
$$. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

where:

h_o' = heat-transfer coefficient in gas film, $\frac{\text{Btu}}{\text{hr} - \text{ft}^2 - \text{F}}$

t_g = temperature of main bulk of the gas vapor mixture, F

t_c = temperature of condensate at gas-condensate interface, F

K_M = mass-transfer coefficient, $\frac{\text{lb}}{(\text{hr} - \text{ft}^2) \text{ per unit pressure}}$

λ = latent heat of condensation, Btu/lb

p_v = partial pressure of vapor in main bulk of the gas vapor mixture, $\frac{\text{lb}}{\text{sq in.}}$

p_c = vapor pressure at t_c, lb/sq in.

t_w = water temperature, F

$U_{comb.}$ = combined conductances other than the gas film

$$= \frac{1}{\frac{1}{h_{cond}} + r_o' + r_f + r_m\left(\frac{A_o}{A_m}\right) + \left(\frac{A_o}{A_i}\right) r_i + \frac{A_o}{A_i h_i}} \quad \ldots \ldots \ldots \ldots \ldots \quad (6)$$

where:

$h_{cond.}$ = condensing film coefficient

Other terms defined by Equation 20 of Part 1.[9]

Determining Transfer Coefficients

Gas film heat transfer and mass transfer coefficients (h_o' and K_M respectively) are obtained in the following manner. The fin side gas film heat transfer coefficient is obtained from Equation 1 or 2 of the third article of this series.[6] The relationship for 19 fin-per-in. tubes in unbored shells is:

$$\left(\frac{h_o' D_e}{k}\right) = 0.155 \left(\frac{D_e G}{\mu}\right)^{.6} \left(\frac{C_p \mu}{k}\right)^{1/3} \left(\frac{\mu}{\mu_w}\right)^{0.14} \quad \ldots \quad (7)$$

The fin side gas film mass transfer coefficient is obtained using the heat transfer coefficient obtained from Equation 7 and the "j" factor relationships for heat and mass transfer. The heat transfer "j" factor is defined as:

$$j_h = \frac{h_o'}{C_p G}\left(\frac{C_p \mu}{k}\right)^{2/3} \left(\frac{\mu_w}{\mu}\right)^{0.14} \quad \ldots \ldots \quad (8)$$

The mass transfer "j" factor is defined as:

$$j_m = \frac{K_M M_M P_{gf}}{G M_v}\left(\frac{\mu}{\rho D_v}\right)^{2/3} \quad \ldots \ldots \quad (9)$$

Equating Equations 8 and 9 and simplifying, the mass transfer coefficient is obtained as:

$$K_M = \frac{h_o' M_v}{C_p M_M P_{gf}}\left(\frac{C_p \rho D_v}{k}\right)^{2/3} \left(\frac{\mu_w}{\mu}\right)^{0.14} \quad \ldots \quad (10)$$

where:

j_h = heat-transfer "j" factor (dimensionless)

h_o' = gas-film heat-transfer coefficient, $\frac{\text{Btu}}{\text{hr} - \text{ft}^2 - \text{F}}$

C_p = specific heat at constant pressure, $\frac{\text{Btu}}{\text{lb} - \text{F}}$

G = mass velocity, $\frac{\text{lb}}{\text{hr} - \text{ft}^2}$ of bulk stream

μ = viscosity, $\frac{\text{lb}}{\text{ft} - \text{hr}}$

k = thermal conductivity, $\frac{\text{Btu}}{\text{hr} - \text{ft}^2 - \text{F/ft}}$

j_M = mass-transfer "j" factor (dimensionless)

K_M = mass-transfer coefficient, $\frac{\text{lb}}{\text{hr} - \text{ft}^2 \text{ per unit of pressure}}$

M_M = molecular weight of gas-vapor mixture (average)

M_v = molecular weight of vapor

P_{gf} = log mean partial pressure of noncondensable gas across the film, lb/sq in.

$$P_{gf} = \left[\frac{(P_g) \text{ at } t_g - (P_g) \text{at } t_c}{\ln \frac{(P_g) \text{at } t_g}{(P_g) \text{at } t_c}}\right]$$

P_g = partial pressure of the noncondensable gas in the main body, lb/sq in.

ρ = vapor density, lb/cu ft

D_v = diffusion coefficient, sq ft/hr

$$D_v = 0.0166 \left[\frac{T^{3/2}}{P(V_A^{1/3} + V_B^{1/3})^2}\right] \sqrt{\frac{1}{M_A} + \frac{1}{M_B}}$$

where:

T = absolute temperature, deg Kelvin

for T = deg Rankine, change constant to 0.0069

P = pressure, atmosphere

V_A, V_B = molecular volumes[7]

M_A, M_B = molecule weights of gases and condensing vapors

Combined Heat Transfer Coefficient

The combined coefficient, $U_{comb.}$, defined for finned tubes by Equation 6 is determined in the following manner. The condensing coefficient, $h_{cond.}$, can be determined by the methods given in the second article of this series.[8] The inside and outside fouling factors can be determined in the usual manner. The fin resistance of the tube can be obtained from Table 2 or Fig. 5 of the first article of this series.[9] The inside coefficient and metal resistance are determined in the usual manner. The condensing and water film coefficients vary from the inlet end to discharge end of the exchanger. These resistances are usually small in comparison to the gas film resistance and the variation can ordinarily be neglected.

Heat Transfer Area

To obtain an exact design it is necessary to graphically solve Equation 2 for the heat transfer area. Partial condensers can have either a saturated vapor-gas feed or superheated vapor-gas feed. A different approach to the problem must be taken for the two cases.

A. Design of Partial Condensers with Saturated Feed.

For the design of partial condensers in which the saturated vapor-gas mixture enters and condensation proceeds along the saturation line without superheating or supercooling, the method of Colburn and Hougen[1] is applicable. Fig. 1 shows the cooling-condensing path followed by a saturated feed stream through the heat ex-

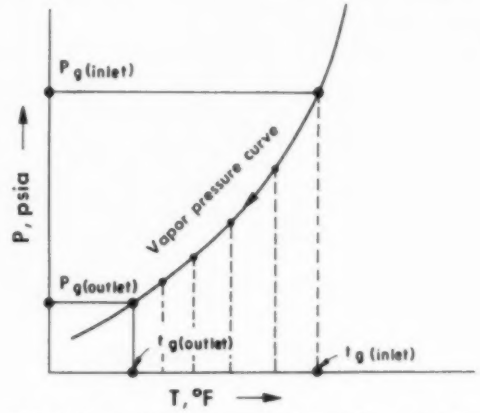


FIG. 1. Vapor pressure curve showing cooling-condensing path of saturated vapor.

You say you have a temperature problem?

If things are getting too hot for you, get in touch with National Tube. We *specialize* in solving temperature problems—and pressure, oxidation, acid and corrosion problems, too. As a matter of fact—as if you hadn't guessed—we make our living by solving *all* types of refinery tubing problems.

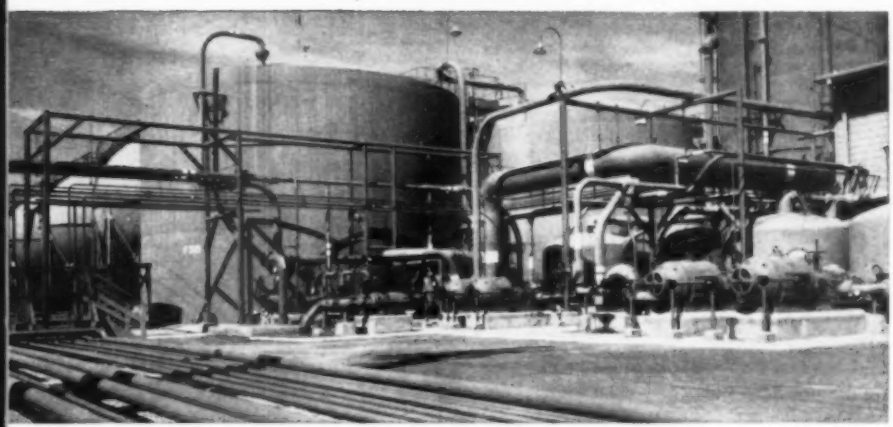
Here's how we do it: for over 60 years we have kept case histories on difficult refinery tubing problems, each of which was solved by one of our steel alloys. From this accumulation of alloy information, National Tube has developed 24 different seamless steel tube analyses, each designed to combat a specific set of refinery conditions. Every one of these analyses has been proved time and time again in actual refinery service. We feel confident that one of them is the answer to your problems.

In addition to these two dozen analyses, other chemical compositions are available in seamless tubular products, and a wide variety of temperature problems is presently under study.

Get in touch with us. Our Mill Service Force, available for field consultation, will help you find just the alloy you need, at the right price, to meet your refinery conditions. Write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

HERE ARE NATIONAL TUBE'S TWO DOZEN DIFFERENT TUBE ANALYSES:

Carbon	5 Cr, ½ Mo	17 Cr
Carbon, ½ Mo	5 Cr, ½ Mo, 1½ Si	18-8
1 Cr, ½ Mo	7 Cr, ½ Mo	18-8 Ti
1¼ Cr, ½ Mo	8 Cr, ½ Mo	18-8 Cb
2 Cr, ½ Mo	8 Cr, 1 Mo	18-8 Mo
2¼ Cr, 1 Mo	9 Cr, 1 Mo	25-20
2½ Cr, ½ Mo, ¾ Si	12 Cr	3½ Ni
3 Cr, 1 Mo	12 Cr, Al	5 Ni



The world's finest tubular products from the best-known name in pipe—*National Tube*

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL SUPPLY DIVISION · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

NATIONAL SEAMLESS PIPE AND TUBES

WELDS WITHOUT WELDS

UNITED STATES STEEL

changer. The heat exchanger is broken up into a series of temperature drop zones as indicated in Fig. 1. Total heat transferred in each zone is computed, sensible plus condensing load. The corresponding water temperatures at these zones are obtained from a heat balance. Equation 7 is solved for each zone by a trial and error procedure on t_c. A plot is then made of $\frac{1}{U_{comb.}\Delta t}$ versus q and the area under the curve is obtained to give the required heat transfer area.

B. Design of Partial Condensers with Superheated Feed.

Fig. 2 shows the cooling-condensing path followed by a superheated feed stream through the heat exchanger. The problem now consists of determining this path. The most convenient method to use is that of Bras[8] which involves the use of the following relationship.

$$\frac{dp_v}{dt} = \left(\frac{P - p_v}{P_{gf}}\right)\left(\frac{C_p \rho D_v}{k}\right)^{2/3}\left(\frac{\Delta p}{\Delta t}\right) \quad . \quad . \quad (11)$$

in which

$\Delta p = p_v - p_c$, see Fig. 3
and $\Delta t = t_g - t_c$, see Fig. 3

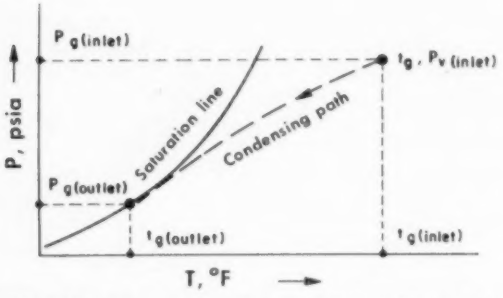


FIG. 2. Vapor pressure curve showing cooling-condensing path of superheated feed.

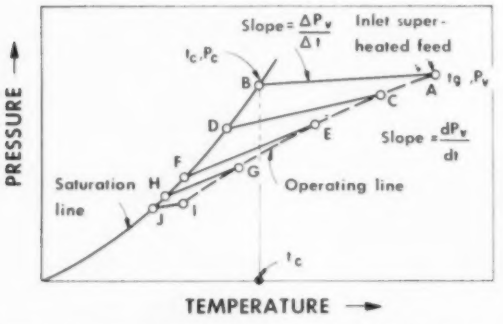


FIG. 3. Illustration of procedure followed to obtain condensing path for superheated feed.

Procedure for the design of partial condenser with superheated vapors in an unsaturated condition requires the following:

1. Composition of vapor-gas mixture entering the unit must be known.
2. Temperature and pressure entering the unit must be known.
3. The partial pressure of the condensible vapor is determined from the composition.
4. Heat-transfer and mass-transfer coefficients can be calculated by use of Equations 7 and 10 (except that P_{gf}, the log mean partial pressure of the noncondensable gas across the film lb/in.^{2} is unknown). Trial-and-error solution of Equation 5 is required giving the temperature and vapor pressure at the condensate layer.
5. $\therefore \Delta t/\Delta p$ can be evaluated and dp/dt calculated from Equation 11.
6. Straight lines are drawn with slope of dp/dt and followed for short distances and the process repeated until the outlet gas temperature is reached as indicated in Fig. 3.
7. About 5 to 10 points are usually sufficient.
8. Solving of Equation 5 from point to point gives $U\Delta t$ values for a graphical solution of Equation 2 as indicated in Fig. 5.

C. Approximation Methods.

The simplest approximation method is to evaluate the terminal overall coefficients and use an average overall coefficient in conjunction with the logarithmic mean temperature difference. Accuracy of the method rapidly decreases as difference between the inlet and outlet overall coefficients increases. Also use of the logarithmic mean temperature difference implies assumptions which are usually not valid for partial condensers.

A more reliable method consists of multiplying a mean gas film heat transfer coefficient by the ratio of the total to sensible heat transfer for the unit as indicated by Carrier and Anderson.[10]

$$h = h_o'\left(\frac{q_s + q_L}{q_s}\right) \quad . \quad . \quad . \quad . \quad (12)$$

The outside weighted coefficient, h, is then used in Equation 20 of the first article[9] in place of h_o'. This overall coefficient can be used with an integrated temperature difference as indicated by Gilmour[11] to obtain the required area.

Cairns has presented a method of formally integrating Equation 2 if the $U\Delta t$ versus q curve is of parabolic shape.[2] The required heat transfer area is given by:

$$A = \int_{-q_{T/2}}^{+q_{T/2}} \frac{dq}{(aq^2 + bq + c)} \quad . \quad . \quad . \quad . \quad . \quad (13)$$

$$a = \frac{2[(U\Delta t)_2 + (U\Delta t)_1 - 2(U\Delta t)_{mid}]}{q_T{}^2}$$

$(U\Delta t)_1$ = heat flux at the gas-vapor outlet
$(U\Delta t)_{mid}$ = heat flux at a point in the cooler-condenser where half the total heat has been transferred
$(U\Delta t)_2$ = heat flux at the gas-vapor inlet

Equation 13 has three solutions:

when $b^2 = 4ac$

$$A = \left[\frac{-2}{aq + b}\right]_{-q_T}^{+q_T} \quad . \quad . \quad . \quad . \quad . \quad (14)$$

when $b^2 > 4ac$

$$A = \left[\frac{1}{\sqrt{b^2 - 4ac}} \ln\left(\frac{aq + b - \sqrt{b^2 - 4ac}}{aq + b + \sqrt{b^2 - 4ac}}\right)\right]_{-q_T}^{+q_T} \quad (15)$$

for $b^2 < 4ac$

$$A = \left[\frac{2}{\sqrt{4ac - b^2}} \tan^{-1}\left(\frac{\sqrt{aq + b}}{\sqrt{4ac - b^2}}\right)\right]_{-q_T}^{+q_T} \quad (16)$$

As indicated, this method requires knowing the values of $(U\Delta t)$ at each end of the cooler-condenser and at a point in the cooler-condenser where half the total heat

removed has been transferred. It is then possible to calculate the values of the constants a, b, and c in Equation 13. The appropriate integrated equation (14, 15, or 16) is then solved depending on whether $b^2 \gtrless 4ac$. The required area for the conditions specified is thus obtained. The only limitation on this method is that $(U\Delta t)$ when plotted against q must approach a part of a parabola.

Another approximation method also based upon the assumption of a parabolic curve of $(U\Delta t)$ versus q is that involving the use of a graph by Carey and Williamson.[12] The graph gives a factor f which is used to multiply the mid-point heat flux $(U\Delta t)_{mid}$ to obtain the mean heat flux.

An alternate graphical procedure involving polar diagrams has been presented by Bras.[4] The method is limited to the Colburn and Hougen (saturated gas-vapor mixture feed) method.[1] The method gives the exact solution and does not require a parabolic q versus $(U\Delta t)$ curve. The tedious successive approximation computations of the Colburn-Hougen method are greatly reduced by the graphical procedure using the polar diagram.

D. Gas Phase Condensation.

The previous discussions are based on the assumption of surface condensation, i.e., the condensation of the condensable vapor occurs on the surface of the bare or finned tube. The graphical integration method of Colburn and Hougen assumes that the heat transfer and mass transfer mechanisms operate without interaction. As the gas-vapor mixture flows past the cooling surface, mass and sensible heat are transferred at rates proportional to their respective driving forces. In some systems, particularly those involving high molecular weight vapors and low diffusivity, mass transfer is slower than heat transfer. In such a case either supersaturation or condensation in the gas phase then follows.

Schuler and Abell[15] have presented an interesting and useful design method involving a vapor phase condensation correction factor to allow for gas phase condensation or "fog formation." No attempt will be made to review the method here. The reference should be consulted by those encountering the problem in the design of cooler-condensers in which fog formation is expected to occur.

EXAMPLE OF PARTIAL CONDENSER DESIGN INVOLVING SUPERHEATED FEED

A. Statement of Design Problem.

A 50-50 weight percent mixture of ethane and pentane at a total pressure of 160 psia and 225 F is to be cooled to 100 F in shell-and-tube heat exchanger at the rate of 150,000 lb per hr. Treated cooling tower water is available at 90 F and is to be heated to a temperature not to exceed 110 F. Comparable designs of finned-tube units and plain tube units will be provided. The tubes are to be ¾-in. OD Admiralty tubes, 14 BWG at the ends.

B. Tube Specifications.

1. Finned-Tube Characteristics

14 BWG plain end tube
Trufin 195065-26 Admiralty tube

$N = 19$ fins/in.
$d_o = 0.737$ in.
$d_r = 0.640$ in.
wall thickness $= 0.065$ in.
mean fin thickness $= 0.016$ in.
$d_i = 0.510$ in.
$A_o = 0.438$ ft²/ft
$A_i = 0.1336$ ft²/ft
$A_o/A_i = 3.28$
$A_{cs} = \dfrac{(\pi)(0.510)^2}{(576)} =$ 0.001418 ft²/tube
$D_e = 0.0559$ ft (for fluid flow)

2. Plain Tube Characteristics

14 BWG tube
OD $= 0.750$ in.
ID $= 0.584$ in.
wall thickness $= 0.083$ in.
$A_o = 0.1963$ sq ft/ft
$A_i = 0.153$ sq ft/ft
$\dfrac{A_o}{A_i} = 1.285$
$A_{cs} = \dfrac{\pi(0.584)^2}{576} =$ 0.00186 ft²/tube

Finned Tube Unit

C. Preliminary Heat-Exchanger Arrangement.

Assume a 43-in. ID shell containing 1300 tubes on a 1 in.-45° square pitch with a single pass counter-current flow on shell-and-tube sides. The shell side has baffles with 25 percent window cut on the diameter and spaced at 2.5 ft intervals. Required length of the tubes is to be determined.

D. Sample Calculations for Finned-Tube Unit.

1. Flow areas. Cross-flow areas.

Number of tubes on centerline $= \left(\dfrac{\text{shell diameter}}{\text{pitch}\sqrt{2}} - 1\right) = \left(\dfrac{43}{1.414} - 1\right) = 29$

Number of tubes in flow path $= 2(29) + 1 = 59$ (on zig-zag path)

Number of spaces for flow $= 58$ *plus the ends* (due to floating head backing plates)

Cross-flow face area $= \dfrac{1}{12}(2.5)58 + 2 =$ 12.5 ft²

Root metal projected area $= (D_r)(L)$ (No. of tubes) $= \dfrac{0.64}{12}(2.5)(59) = 7.86$ ft²

Fin metal projected area $=$ (Fin thickness) $(D_o - D_r)$ (fins/ft) (No. of tubes) $(L) = \left(\dfrac{0.016}{12}\right)\left(\dfrac{0.737 - 0.64}{12}\right)(19)(12)(59)(2.5) =$ 0.362 ft²

Free cross-flow area $= 12.5 - 7.86 - 0.36 =$ 4.28 ft²

Total cross-sectional area of shell $= \dfrac{\pi(43)^2}{576} =$ 10.05 ft²

Window area[13] $= (0.15355)\dfrac{(43)^2}{144} = 1.97$ ft²

Number of tubes in window area $= \dfrac{1.97}{10.05}(1300)$ $= 255$ tubes

Free flow area in baffle window $= 1.97 - 255\left[\dfrac{(0.737)^2}{576}\pi\right] = 1.97 - 0.75 = 1.22$ ft²

Geometric mean area $= \sqrt{(1.22)(4.28)} =$ 2.30 ft²

2. Calculation of Heat Load. Assume that the partial pressure of pentane leaving the exchanger will equal the vapor pressure. Then the partial pressure of pentane in the exit gas stream is 15.0 psi (from vapor

pressure curve, see Fig. 4). Therefore, the mole fraction of pentane in the exit stream is $\left(\frac{15}{160}\right) = 0.0938$. Assuming that no ethane condenses, moles per hour of ethane in exit stream $= \left(\frac{75{,}000}{30}\right) = 2500$. Therefore, moles per hour of pentane vapor in exit gas stream $= \frac{2500(0.0938)}{(1.000 - 0.0938)} = 258$.

Lb/hr of pentane vapor leaving = (258)(72) = 18,600 lb/hr.
Lb/hr of pentane liquid leaving = (75,000 − 18,600) = 56,400 lb/hr.
Lb/hr of ethane gas leaving = 75,000 lb/hr.

The path selected for computing the heat removed was to condense the pentane at 225 F, cool the condensate to 100 F, and cool the gases from 225 F to 100 F.

Heat Removed:

Condensing = (56,400)(113) =	6,370,000 Btu/hr
Condensate cooling = (56,400)(0.60)(225 − 100) =	4,220,000 Btu/hr
Cooling pentane vapor = (18,600)(0.425)(225 − 100) =	990,000 Btu/hr
Cooling ethane vapor = (75,000)(0.46)(225 − 100) =	4,310,000 Btu/hr
Total Q =	15,890,000 Btu/hr

3. Determination of water requirements.
   Temp rise of water = (110 − 90) = 20 F
   Lb water/hr $= \frac{15{,}890{,}000}{20} = 794{,}500$ lb/hr
   Ft³/hr of water $= \frac{794{,}500}{62} = 12{,}800$ ft³/hr

4. Water velocity in tubes.
   $A_{ts} = 0.001418$ ft²/tube
   Tube side-flow area = (1300)(0.001418) = 1.84 ft²
   Velocity inside tubes at avg water conditions = $\frac{12{,}800}{(3600)(1.84)} = 1.93$ ft/sec

5. Determination of resistances to heat transfer.
   (a) Fouling, inside = 0.001 (from TEMA)[17]
   (a) Fouling, outside = 0.0005 (from TEMA)[17]
   (c) Metal resistance $= \frac{X}{K}\left(\frac{A_o}{A_m}\right)$

$$A_m = \pi\left[\frac{Dr - Di}{\ln \frac{Dr}{Di}}\right] = 3.14\,\frac{(0.0534 - 0.0425)}{\ln \frac{0.0534}{0.0425}} = 0.1535 \text{ ft}^2/\text{ft length}$$

$$r_m = \frac{(0.065)(0.0438)}{(12)(64)(0.1535)} = 0.00024\,\frac{\text{hr} - \text{F} - \text{ft}^2(\text{outside})}{\text{Btu}}$$

   (d) Water side coefficient:[14]

$$h_i = 150\,(1 + 0.011\,t_w)\,\frac{V_t^{0.8}}{d_i^{0.2}}$$

where:
V_t = velocity, ft/sec
d_i = inside diameter of tubes, in.
t_w = average water temperature, F

$$\therefore h_i = \frac{150(2.10)(1.69)}{0.874} = 610\,\frac{\text{hr} - \text{F} - \text{ft}^2(\text{inside})}{\text{Btu}}$$

   (e) Condensing coefficient.

The condensing coefficient will vary throughout the exchanger, being lowest at the inlet, where there is a large temperature difference driving force for heat transfer, and highest at the outlet. Often the coefficient may be assumed constant, due to the controlling nature of the gas-film resistances. A calculation is included here to illustrate the procedure.

The determination of the condensing coefficient involves a trial-and-error computation which can be solved only when the gas-condensate interface temperature is known. Since the ΔT is large in this inlet section, assume h_c = 600 Btu/hr − F − ft². This is checked after establishing t_c.

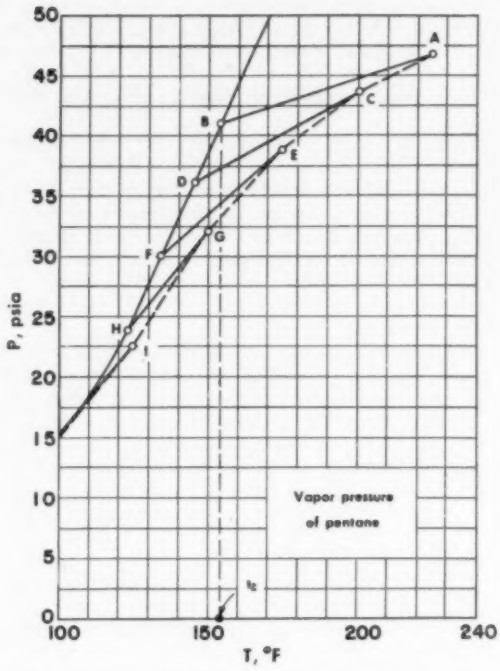


FIG. 4. Condensing path in finned tube partial condensers.

   (f) Fin resistance.
   For this tube, $r_f = 0.00011$ (see Table 2 or Fig. 5[9]).

   (g) Determination of ($U_{comb.}$) in Equation 5.

$$U_{comb.} = \frac{1}{\frac{A_o}{A_i h_i} + r_i\frac{A_o}{A_i} + r_m + r_f + r_o' + \frac{1}{h_{cond}}} = \frac{1}{\frac{3.28}{610} + 0.00328 + 0.00024 + 0.00011 + 0.0005 + \frac{1}{600}}$$

$$= \frac{1}{0.01118} = 89.5\,\frac{\text{Btu}}{\text{hr} - \text{F} - \text{ft}^2(\text{outside area})}$$

   (h) Determination of gas-film coefficient.
   Reference is made to Equation 7.

$$\frac{h_o' D_e}{k} = 0.155\left(\frac{D_e G}{\mu}\right)^{0.6}\left(\frac{C_p \mu}{k}\right)^{1/3}\left(\frac{\mu}{\mu_w}\right)^{0.14}$$

REGENERATES IN SITU!

Higher octane levels and longer catalyst life...

with existing equipment

...merely by replacing with Sinclair-Baker RD 150 Platinum Catalyst

If you have the pi
octane rating and pro
equipment, investigate
of Sinclair-Baker RD 150 Pl
Its efficiency in producing
at high octane levels is
long period of RD 150 oper
other catalyst . . . further,
Cost is sharply redu

A Baker representative will
tailed information, upon re
fidential nature are of cou

BAKER & CO., INC.
WILL HENCEFORTH BE DESIGNATED AS
ENGELHARD INDUSTRIES, INC.
CHEMICAL DIVISION
113 ASTOR STREET
NEWARK, NEW JERSEY

INC.
NEW JERSEY
LES • CHICAGO
INDUSTRIES

The physical properties of the gas-vapor mixture are:

$C_p = 0.478$
$\mu = 0.0245$
$k = 0.01445$

Substituting:

$$= 0.155\left(\frac{0.0559 \times 150{,}000}{2.30 \times 0.0245}\right)^{0.6}\left(\frac{0.478 \times 0.0245}{0.01445}\right)^{1/3}\left(\frac{\mu}{\mu_w}\right)^{0.14}$$

assuming $\left(\frac{\mu}{\mu_w}\right)^{0.14} = 1$:

$$h_o' = \frac{0.01445}{0.0559} \cdot (183.5) = 47.6$$

(i) Determination of mass transfer coefficient from Equation 10:

$$K_M = \frac{h_o' M_v}{C_p M_M P_{gf}}\left(\frac{C_p \rho D_v}{k}\right)^{2/3}\left(\frac{\mu_w}{\mu}\right)^{0.14}$$

It is assumed that $\left(\frac{\mu_w}{\mu}\right) = 1$

Substituting in the equation for D_v:

$$D_v = \frac{(0.0069)(18{,}000)}{(10.9)(8.64)^2}\sqrt{\frac{1}{30} + \frac{1}{72}} = 0.0332 \text{ ft}^2/\text{hr}$$

The density is computed to be:

$\rho = 0.961$ lb/ft^3
$M_M = 30(0.706) + 72(0.294) = 42.4$ lb/lb-mole
$M_v = 72$ lb/lb-mole

Substituting

$$K_M = \frac{(47.6)(30)}{(0.478)(42.4)P_{gf}}\left(\frac{0.478 \times 0.961 \times 0.0332}{0.01445}\right)^{2/3}$$

$$= \frac{70.3}{P_{gf}}(1.04) = \frac{73.2}{P_{gf}}$$

(j) Evaluation of $U\Delta t$ product.
Reference is made to Equation 5.

$$h_o'(t_g - t_c) + \frac{K_M(p_v - p_c)}{P_{gf}} = U_{comb.}(t_c - t_w)$$

$$47.6(225 - t_c) + \frac{(70.3)(132)(47 - p_c)}{P_{gf}} = 89.5(t_c - 110)$$

Assume that $t_c = 160$ F
$p_c =$ vapor pressure $= 44$ psia (from Fig. 4)
$P_{gf} = 114$ psia.

Trial, does

$$47.6(225 - 160) + \frac{(70.3)(132)(47 - 44)}{114} = 89.5(50)?$$

$3095 + 244 = 4475$ *no*
$3339 \neq 4475$

Assume that $t_c = 153$ F
$p_c = 41$ psia
$P_{gf} = 116$

Trial, does

$$47.6(72) + \frac{(70.3)(132)(6)}{116} = (89.5)(43)?$$

$3430 + 480 = 3850$ *no*
$3910 \neq 3850$

Apparently, $t_c = 154$ F approx. Therefore, use a value of

$U\Delta T = 3880$

(k) Determination of point "c" (see Fig. 4).

Equation 11 is used to determine the slope, $\frac{dp_v}{dt}$ of the line A-C on Fig. 4.

$$\frac{dp_v}{dt} = \frac{(P - p_v)}{P_{gf}}\left(\frac{P_r}{S_c}\right)^{2/3}\frac{\Delta p}{\Delta t}$$

Locating the temperature of 154 F on Fig. 4 the condensate surface temperature, t_c, on the vapor pressure curve, the value of $\frac{\Delta p}{\Delta t}$ is determined as $\frac{6}{72}$.

Then,

$$\frac{dp_v}{dt} = \left(\frac{160 - 41}{116}\right)\left(\frac{0.88}{0.8155}\right)\left(\frac{6}{72}\right) = 0.092$$

(l) Check of assumed condensing coefficient.

$U\Delta T = 3880$
$\Delta T = 225 - 110 = 115$ F
$U_o = 33.8$ Btu/hr − F − ft^2(outside area)

$$\frac{\Delta T}{\Delta t_c} = \frac{h_c}{U_o}$$

$$\Delta t_c = \frac{33.8}{600}(115) = 6.47 \text{ F}$$

From Reference 8: (Equation 7a, Part 2).

$$h_{cond.} = 0.725\left(\frac{C_N}{N^{1/4}}\right)\left(\frac{K_f^3 \rho_f^2 g_c}{u_f}\right)^{1/4}\left(\frac{1}{D_e' q}\right)^{1/4}\left(\frac{1}{\Delta t_c}\right)^{1/4}(\lambda)^{1/4}$$

For this bundle,

$N = 0.40(X)^{0.54} = 19$

$\frac{C_N}{N^{1/4}} = 0.76$ (using Freon 12 line of Fig. 1 of the second article[8])

$\left(\frac{1}{\Delta t_c}\right)^{1/4} = 0.627$

$\lambda^{1/4} = 3.35$

$\left(\frac{1}{D_e' q}\right)^{1/4} = 3.5$ (from second article[8])

$$\therefore h_{cond.} = 4.14\left(\frac{K_f^3 \rho_f^2 g_c}{\mu_f}\right)^{1/4}$$

t_f F	$\left(\frac{K_f^3 \rho_f^2 g_c}{\mu_f}\right)^{1/4}$
90	156
110	159
130	160
150	161
170	161.5

$t_f = 154.-3.2 = 150.8$ F

$$\therefore \left(\frac{K_f^3 \rho_f^2 g_c}{\mu_f}\right)^{1/4} = 161$$

$\therefore h_{cond.} = 4.14(161) = 665$ Btu/hr − F − ft^2 (outside area)

(The assumed value was 600)

F. Determination of Required Heat Transfer Area.

1. Finned-tube unit. Calculations were made for other points by the above procedure and are listed in Table 1. A plot of $10^4/U\Delta t$ vs $q/10^4$ is given in Fig. 5. The shaded area of the curve represents the solution of Equation 2.

$$A = \int_0^q \frac{dq}{U\Delta t} = 9840 \text{ ft}^2$$

Area per foot of length = 0.438 ft²/ft
Length of tubing required = 2240 ft
Using 1300 tubes, required length is 17.25 ft.
Using an 18-ft exchanger provides 4.3 percent excess area.

2. Plain tube unit. The required area was found to be 6550 ft for the same shell-and-tube arrangement. This requires 25.7 ft of exchanger; the use of two 14-ft units provides an excess area of 8.95 percent. The area was obtained from the values given in Table 2.
3. Checks of finned tube area by Carey and Williamson method.[12]

$$y_1 = (U\Delta t)_{inlet} = 3880$$
$$y_m = (U\Delta t)_{mid} = 2370$$
$$y_2 = (U\Delta t)_{outlet} = 368$$
$$\therefore \frac{y_m}{y_2} = \frac{2370}{368} = 6.45$$
$$\frac{y_m}{y_1} = \frac{2370}{3880} = 0.61$$

Using these values, f from chart is = 0.685
$\therefore$ Mean driving force = $fy_m = (0.685)(2370)$

$$\therefore (U\Delta t)_{mean} = 1625$$
$$\therefore A = \frac{15{,}900{,}000}{1625} = 9780 \text{ sq ft as compared with } 9840 \text{ sq ft}$$

G. Comparison of Initial Costs.

1. Finned tube unit. Cost of the finned tube exchanger is obtained from a recent article by Kern and Associates[16] as:

Finned tube unit cost = $26,000

2. Plain tube unit. Cost of the bare tube exchangers is obtained from the same article[16] as:

Bare tube costs (per shell) = $16,200

or

Total cost = 2 × 16,200 = $32,400

3. Comparison of costs. Use of the finned tube exchanger yields a saving of:

$32,400 − $26,000 = $6400.

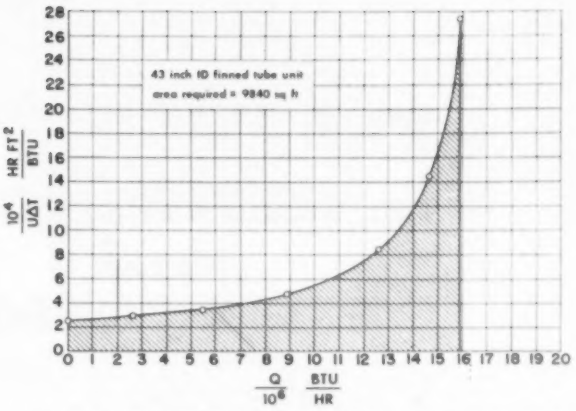


FIG. 5. Graphical solution of Equation 2 for example design of the finned tube unit.

Acknowledgment

Permission by Wolverine Tube Division of Calumet and Hecla, Inc. to publish this paper is appreciated.

TABLE 1. Computed Values for Finned-Tube Unit.

Gas Temp. F	Condensate Film Temp. F	Water Temp. F	Pentane Vapor lb/hr	Q/10⁶ Btu/hr	UΔt Btu/hr-ft²	U_o Btu/hr-ft² F	10⁴/UΔt hr-ft²/Btu
225	154	110	75,000		3880	33.8	2.58
200	145	106.6	67,350	266.85	3600	38.6	2.78
175	134	103	58,150	550.4	2930	40.7	3.41
150	121	98.5	45,100	893.0	2150	41.7	4.65
125	104	93.8	29,700	1265	1190	38.4	8.40
110	99	91.1	22,900	1472	690	36.5	14.5
100	94	90	18,500	1590	368	36.8	27.4

TABLE 2. Computed Values for Plain Tube Units.

Gas Temp. F	Condensate Film Temp. F	Water Temp. F	Pentane Vapor lb/hr	Q/10⁶ Btu/hr	UΔt Btu/hr-ft²	U_o Btu/hr-ft²	10⁴/UΔt hr-ft²/Btu
225	157	110	75,000		6060	52.7	1.65
200	148	107.1	70,900	224.6	5290	57.0	1.89
175	136	103.1	59,200	539.5	4240	59.0	2.36
150	122	98.5	46,000	889.0	3000	58.4	3.33
125	107	93.8	29,700	1265	1750	56.2	5.70
110	100	91.1	22,900	1472	1070	55.4	9.35
100	94	90	18,500	1590	524	52.4	19.10

References

1. Colburn, A. P. and Hougen, O. A., "Design of Cooler Condensers for Mixtures of Vapors with Noncondensing Gases," *Ind. and Eng. Chem.*, Vol. 26, No. 11, 1934, pp. 1178-1182.
2. Cairns, B. C., "Approximation Methods for Designing Cooler-Condensers," *Chem. Engr. Science*, Vol. 3, 1954, pp. 215-227.
3. Bras, G. H. P., "Shortcut to Cooler Condenser Design," *Chem. Eng.*, Vol. 60, 1953, pp. 190-192.
4. Bras, G. H. P., "Polar Diagrams Speed Cooler-Condenser Design," *Pet. Refiner*, Vol. 36, 1957, pp. 149-154.
5. Mickley, H. S., "Design of Forced Draft Air Conditioning Equipment," *Chem. Eng. Prog.*, Vol. 45, 1949, p. 739.
6. Young, E. H. and Ward, D. J., "Design of Finned Tube Heaters and Coolers," *Refining Engr.*, Vol. 29, October 1957.
7. Brown, G. G. and Assoc., *Unit Operations*, J. Wiley and Sons, Table 54, p. 515.
8. Young, E. H. and Ward, D. J., "Design of Finned Tube Condensers," *Refining Engineer*, Vol. 29, November 1957.
9. Young, E. H. and Ward, D. J., "Fundamentals of Finned Tube Heat Transfer," *Refining Engr.*, Vol. 29, December 1957.
10. Carrier, W. H. and Anderson, S. W., "The Resistance to Heat Flow Through Finned Tubing," Heating, Piping, and Air Conditioning, May 1944, ASHVE Journal Section, pp. 304-318.
11. Gilmour, C. H., "Shortcut to Heat Exchanger Design — VI," *Chem. Eng.*, 61, p. 212.
12. Carey, W. F. and Williamson, G. J., Inst. Mech. Engrs. Steam Group Proc., 1950, 163, pp. 41-53.
13. Perry, J. H., *Chem. Engrs'. Handbook*, 3rd Edition, McGraw-Hill, 1954, p. 32.
14. McAdams, W. H., *Heat Transmission*, 3rd Edition, McGraw-Hill, 1954, p. 228.
15. Schuler, R. W. and Abell, V. B., "Heat Transfer and Mass Transfer in Cooler Condensers: Titanium Tetrachloride-Nitrogen System," Preprint 12, Heat Transfer Symposium, AIChE National Meeting, Louisville, Kentucky, March 1955.
16. Kern, D. Q. and Associates, "Compare Exchanger Costs Quickly," *Pet. Refiner*, Vol. 35, August 1956.
17. "Standards of Tubular Exchanger Manufacturers Association," 3rd Edition, TEMA, New York, 1953.

★ ★ ★

Plastic pipe and structures show ever-increasing applications, due to improved technology and development of manufacturing standards

PLASTICS in REFINING and PETROCHEMICALS PLANTS

Dr. Raymond B. Seymour
President, Loven Chemical of California

IN A RECENT survey by task committee T5-D of the National Association of Corrosion Engineers, an engineer in a large petrochemical plant was asked to give his opinion on the use of plastics in his industry. While admitting that his firm was fortunate in being able to sell various products to the plastics industry, he stated emphatically that in his opinion, plastics could not be used as materials of construction in his plant.

Nevertheless, many successful uses of plastics were revealed during a subsequent plant trip. Some of the uses discovered are outlined in Table 1.

This engineer who was convinced that the potential use of plastics in his plant was limited, praised these applications highly. It is not the purpose of this report to be commercial or to emphasize trade-names. The experience cited above, however, is typical and should be brought to the attention of both engineers and purchasing agents.

Regardless of end uses or trade names, the plastics engineer must know his materials, their advantages, disadvantages, and availability. This knowledge, coupled with sound design, will provide greater service and wider acceptance of plastic structures.

Plastic Construction Materials

Products that have the greatest potential in the chemical and petroleum process industries are cellulose acetate butyrate, polyethylene, styrene rubber blends, saran, polyvinyl chloride, polyfluoro carbons, polychloro ethers, phenolics, furan, and epoxy resins.

Properties of interest to engineers in

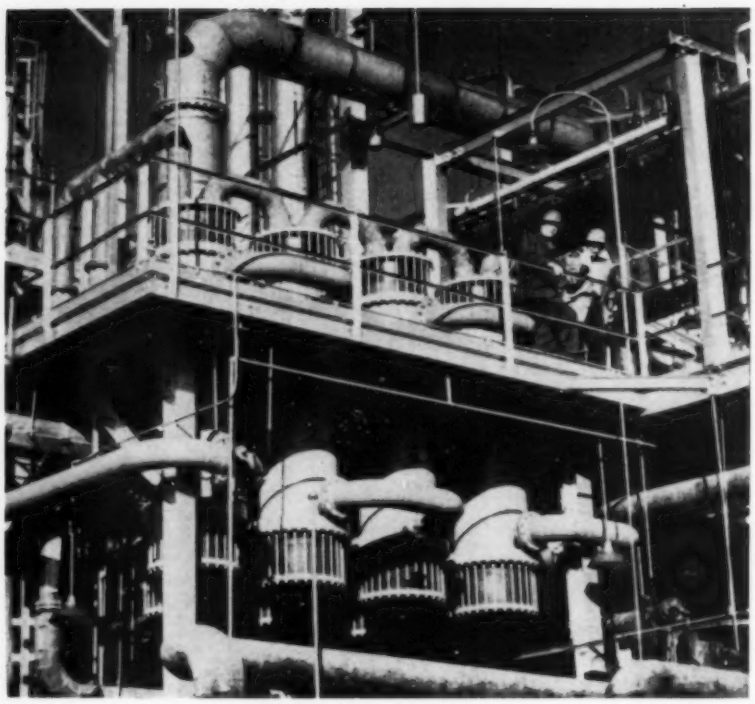
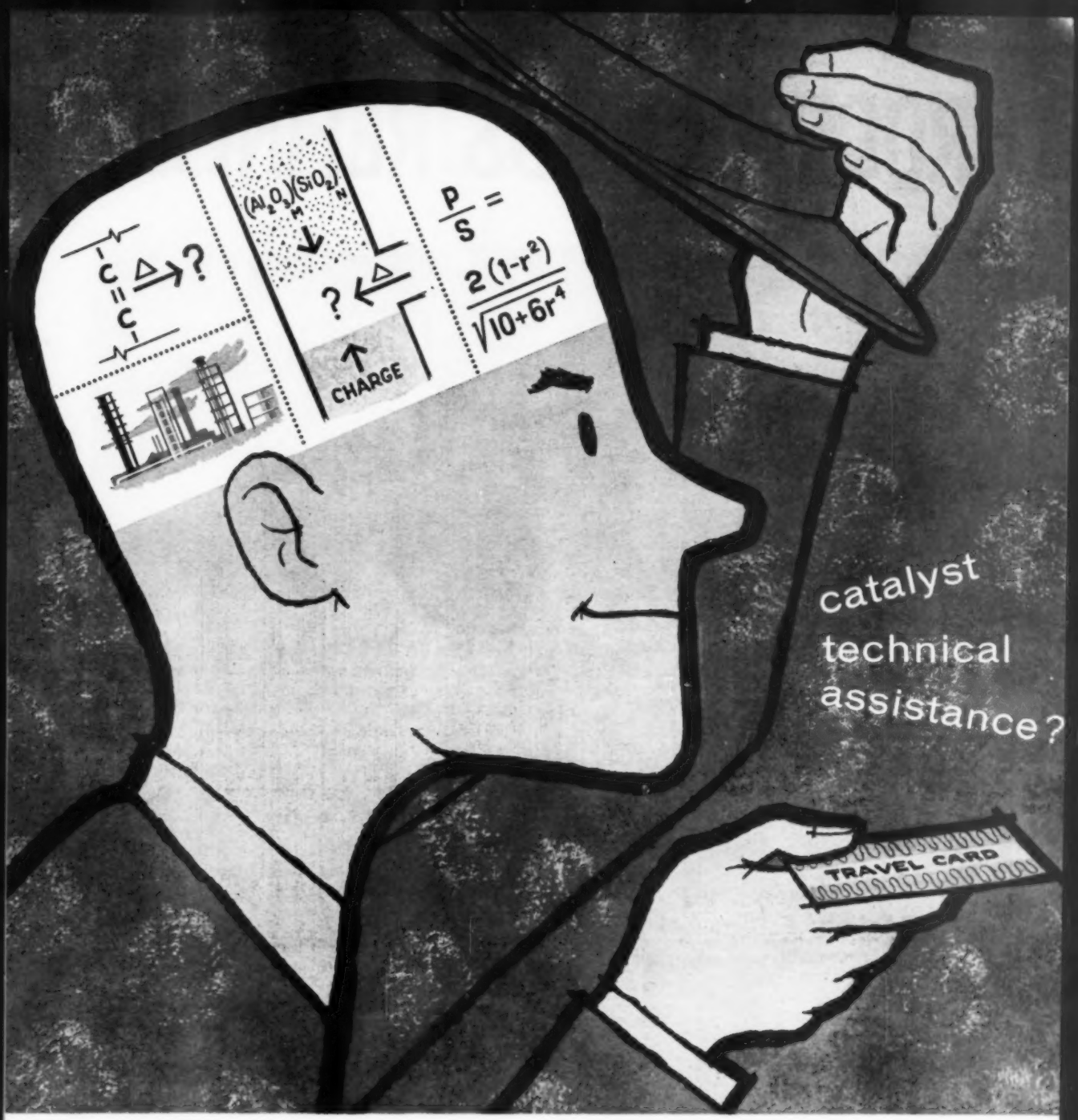


FIG. 1. Installation of large "Karbate" shell and tube heat exchangers in a petrochemical plant. Tubes, tube sheets, and covers are made from phenolic resin impregnated graphite.
—Courtesy National Carbon Company

TABLE 1. Applications of Plastics in a Petrochemical Plant.

Trade Name	Product	Equipment	Length of Service
Haveg	Asbestos-phenolic	Tower	4 years
Karbate	Plastic impregnated graphite	Heat exchanger	3 years
	Vinyl plastisol joints	Waste disposal ippe	6 months
Microballoons	Phenolic foam	Evaporation barrier	18 months
Isofoam	Polyurethane foam	Tank insulation	15 months
Teflon	Polytetrafluorethylene	Valve liner	5 years
Amercoat	Vinyl film	Protective coating	2 years
Alkor	Furan cement mortar	Waste disposal system	3 years
Saran-lined pipe	Vinylidene chloride copolymer	Acid lines	5 years
Polykem	Polyethylene tape	Pipe wrapping	2 years
Thiokol	Polyethylene sulfide	Sealant	6 months
Lastiglas	Phenolic coating	Tank lining	4 years

*Presented at the 1957 Annual Conference, Society of the Plastics Industry, March 20, 1957, Los Angeles, California.



The Man from Davison is quick with a travel card, quick with your answer

The Man from Davison will go anywhere any time. He's worked in advisory capacity on hundreds of complex petroleum catalyst jobs. He is best qualified to help you arrive at the most practical and economical answer to your catalyst needs. He's ready to put his experience and knowledge to work on your problem. He's available at once.

DAVISON
CHEMICAL COMPANY
Division of W. R. Grace & Co.
Baltimore 3, Maryland

Buy DAVISON—the quality catalyst backed up by experience, research, technical assistance, service!

Los Angeles, California.

PROCON BUILDS REFINERY

we plan the refinery, every requirement, every detail is carefully anticipated. Process units that will perform as required are incorporated into an efficient design.

we train 85% of the native Cuban workmen in the technicalities of construction. These men were developed into highly skilled workers, other previously trained mechanics were up-graded and perfected in various construction trades.

we solve some tough problems. 1 and 2. Prefabricated crude atmospheric column was unloaded and floated ashore overcoming expensive and time-consuming transport problem. 3. Prefabricated panels go on Platformer and crude heaters. 4. Some of the foundations and piping trenches were blasted from solid rock.

work on your problem. He's available at once.

Baltimore 3, Maryland

Buy DAVISON—the quality catalyst backed up by experience, research, technical assistance, service!

FOR TEXACO IN CUBA

And here's how we did it . . . Solving challenging construction problems proves Procon's ingenuity.

It's a pretty exacting business at best, building a refinery from scratch. Add a double handful of natural, geographical and human problems to it and you've got a fairly clear picture of the challenges Procon met and overcame to give The Texas Company (West Indies) Limited this handsome refinery, the first ever built in eastern Cuba.

The pictures you see here tell some of the story of how this 20,000 BPSD refinery was built by Procon three miles south across the bay from Santiago.

If you have a refinery in mind . . . or a petrochemical plant, or a chemical plant or individual process units for any of these . . . you can be sure of top-flight construction anywhere in the world when you call on Procon to do the job.

The refinery is served by a deep-water dock that accommodates two tankers simultaneously. Procon laid a 24-inch crude line and auxiliary piping to pipe feed stock directly into processing area.

PROCON *International, S. A.*

JOSE A. SACO, NO. 6, SANTIAGO DE CUBA

PROCON INCORPORATED, DES PLAINES, ILLINOIS, U. S. A.
PROCON (CANADA) LIMITED, TORONTO 18, ONTARIO, CANADA
PROCON (GREAT BRITAIN) LIMITED, LONDON, W. C. 2, ENGLAND

WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

And here's the finished job. A beauty, capable of pumping 20,000 barrels a day into the hungry transport arteries of Cuba and adjoining countries.

—Courtesy U. S. Rubber Company

FIG. 2. "Uscolite" plastic pipe and fittings were installed four years ago at this midwestern refinery. Continuous support of the pipe, usually required when operating temperature approaches the 170 F maximum recommended for this pipe, serves also to protect against excessive mechanical abuse.

these industries are summarized in Table 2.

Pertinent characteristics of these materials are:

Cellulose acetate butyrate. Cellulose acetate butyrate lacks resistance to corrosive chemicals and many organic solvents. Pipe extruded from this plastic has been used successfully for potable water, salt water, natural gas, and petroleum crudes.

Polyethylene. Regardless of nomenclature, both types of polyethylene have excellent resistance to corrosives but are not suitable for use with many organic solvents. Pipe extruded from properly compounded virgin polyethylene prepared by the high-pressure process has performed well. When designed properly, fabricated by good workmen, and supported adequately, vessels and ducts of this type of polyethylene have performed satisfactorily.

Because of its greater rigidity, pipe extruded from the product made at lower pressures may be joined by threading. Vessels and ducts fabricated from this material require less support than those fabricated from the flexible product. Experience with this newer type product is limited and little engineering and design data have been published.

Styrene rubber blends. Pipe, vessels, and ducts fabricated from blends and copolymers of acrylonitrile with styrene or butadiene as well as a three-component copolymer of these monomers have good resistance to corrosives, but should not be used with active solvents.

Saran. While saran was a pioneer plastic material of construction, it has not been used as widely as some of the newer products. Saran has good resistance to most corrosive chemicals and petroleum products.

It is used primarily as tubing and for lining pipe. When used in these applications it has an enviable record of performance in the petroleum and process industries.

Polyvinyl chloride. Plasticized polyvinyl chloride tubing and tank lining has an excellent record of performance in both the petroleum and chemical process industries. Rigid polyvinyl chloride pipe, while used to less extent in this country, has excellent resistance to many chemicals and also to petroleum solvents.

Rigid polyvinyl pipe may be joined by threading, thermo-welding, or solvent-welding. Sheets of this material may be formed and thermo or solvent welded. Based on the many uses of this material in European chemical industry, it may be predicted that the product will find wider acceptance in this country.

Polyfluoro carbons. While somewhat more expensive than other plastics, polyfluoro carbons have excellent resistance to all corrosives and are more resistant to elevated temperatures than most plastics. They have been used for high-temperature service and are now being used as a pipe lining. This material is also applied as a tank lining through the use of a glass cloth backing.

Polychloro ether. This product, while somewhat expensive and still in the pilot plant stage is comparable in chemical resistance to polyfluoro carbons. It has been extruded as pipe and has been used to a small extent as a lining for vessels in both the petrochemical and chemical process industries.

Phenolic resins. Phenolic resins have poor resistance to alkalis but excellent resistance to petroleum salts and non-oxidizing acids at temperatures up to 300 F. When modified with epoxy resins, some of the brittleness of these products is overcome.

Phenolic lined pipe, phenolic lined vessels and phenolic impregnated graphite have been used for many years in the chemical process industries. Self-supporting vessels and pipe fabricated from mixtures of phenolic resin and asbestos have also been used successfully in this industry.

Furan resins. Resistance of furan resins is comparable to that of phenolic resins with the exception that these materials also are resistant to alkalis. Their use, however, has been limited somewhat since phenolic resins are satisfactory for most applications in the petrochemical and chemical process industries.

Epoxy resins. In spite of their high cost, epoxy resins have been accepted by both the petrochemical and chemical process industries. Epoxy resins have been used widely for coating pipe and equipment.

Glass orspolyacrylonitrile fibers impregnated with epoxy resins have proved to be much more satisfactory in the chemical process industry than polyester-fiberglass combinations. As shown in Table 2, epoxy resins meet many of the basic requirements of the chemical process industry.

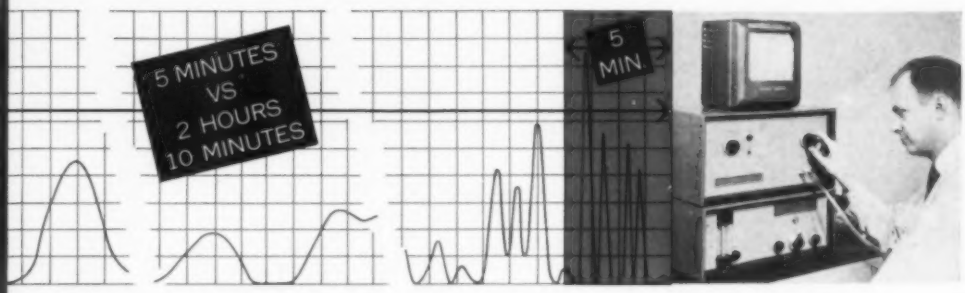
Engineering Plastic Structures

In addition to knowing the advantages and disadvantages of the available materials, it is also essential that plastic engineers assure their customers the benefit of such knowledge. It is not the purpose of this report to reprimand the plastics industry for its many mistakes. Certainly, at least as many

TABLE 2. Properties of Plastics as Materials of Construction.

	Uses			Resistance to				
Product	Pipe	Vessels	Ducts	Petroleum	Salts	Alkalis	Acids	Temperature
Cellulose acetate butyrate	—	—	—	F	G	P	P	F
Polyethylene	—	—	—	F	E	E	E	F
Styrene rubber blends	—	—	—	F-G	E	VG	VG	G
Saran	—	—	—	E	E	E	E	G
Polyvinyl chloride	—	—	—	E	E	E	E	G
Polyfluorocarbons	—	Lining	—	E	E	E	E	E
Polychloro ether	—	Lining	—	E	E	E	E	E
Phenolics	—	—	—	E	E	P	E	E
Furan	—	—	—	E	E	E	E	E
Epoxy	—	—	—	E	E	VG	E	E

Faster analyses... assure faster instrument payout



26 runs through n-pentane

in the same time

usually required

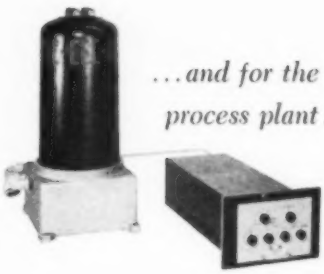
for one run through C_{10}

CEC's versatile laboratory chromatograph

Easily operated by untrained help, CEC's rugged 26-201A guarantees speed and superior reproducibility. An *exclusive* Thermostatted Pre-Cut Column eliminates any chosen portion of the heavier sample fraction from the analysis of a complex mixture – thus reducing the analysis time from 130 minutes to 5 minutes!

Other CEC exclusives are a capillary sampling accessory which permits obtaining a representative sample from a high-pressure source, thus eliminating the use of fragile hypodermic syringes. Also, a heated sample vaporizer which vaporizes liquid-samples and assures a sample reproducibility of better than ±0.5%, without reliance on operator skill. Sensitivity in parts-per-million and unique, self-contained modular construction offer maximum flexibility, maximum economy.

For complete information, contact your nearest CEC Field Office, or write for Bulletin CEC 1831A-X2.



...and for the process plant...

CEC's reliable process chromatograph

For automatic, continuous remote control and for the recording of multiple streams, no instrument can surpass the 26-202's simplicity, precise reproducibility, and precise regulation. Sample volumes are reproducible to better than ±0.5%, temperatures are controlled to within less than 1°F. Design considerations permit the analyzer to be situated at least 500 feet from the control unit. Analyzer is constructed to meet the requirements of Class I, Group D, Division 1 hazardous locations. *Write for Bulletin CEC 1836-X20.*

NO MATTER WHAT YOUR PROBLEMS ARE...

Simply state your needs – CEC's application and system engineers are available to design and install complete systems for any application requirements. *Contact your nearby CEC Field Office.*

Analytical & Control Instruments Division

Consolidated Electrodynamics

300 North Sierra Madre Villa, Pasadena, California

OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

mistakes have been made by other industries supplying materials of construction to the chemical process industry. Fortunately, many of these mistakes have been forgotten as these industries matured.

While admittedly not all information desired by design engineers is available, sufficient information exists to permit the fabrication of any tank, tank liner, flume, or duct. It must be admitted, however, that it may be essential to use a high safety factor, and this has been the custom for reputable plastic fabricators in this country and abroad.

Price vs Performance

Products with a safety factor of less than one usually cost less initially. Presumably because of a lack of knowledge, the difference between under-designed and properly designed plastic structures is sometimes overlooked. The reputable segment of the plastics business is concerned, but not surprised when undesigned, poorly fabricated structures fail.

It would be ridiculous for any responsible members of the plastics industry to discount these failures. It would be equally ridiculous, however, not to emphasize that many of the failures were due to unrealistic purchasing policies.

Some of the original premises accepted by the plastics industry for plastic structures should be modified. For example, plastic pipe in general has excellent resistance to corrosives, but its strength is not comparable to steel. Instead of attempting to produce thicker sections, therefore it may be prudent to consider the use of thinner pipe inserted in metal pipe as is the case with saran-lined pipe.

Likewise, instead of using heavy, expensive sections for flumes and ducts, it may be more sound to support thinner sections continuously. Potential use of plastic-metal laminates and other composite structures should not be overlooked.

Fiberglass reinforced structures may provide part of the answer. If so, the fiberglass structure should be continuous and not a patchwork of cloth and mat. The resin must be chemically resistant or coated completely with a resistant resinous material. One commercial structure consists of fiberglass reinforced epoxy resin coated on the inside and outside with polyvinyl chloride.

Of course, if high strength is not required, glass mat or sections of glass textile may be used. Concrete, impregnated graphite, glass, and ceramic pipe have been armored satisfactorily with impregnated glass tape.

Unfortunately, rumors have been circulated that construction with plastics is so simple that it can be done with unskilled labor. This unusual concept is sometimes extended to include designing and engineering of plastic structures. Space does not permit the recitation of case histories to prove the fallacy of these concepts. Suffice it to say that most types of plastic fabrications require at least as much skill as pipe fittings, brick laying, and plastering.

Anyone with a small investment can purchase an extruder and produce an end product which looks like pipe. In the absence of standards, significant performance specifications, and proved reliability, purchasers lacking engineering advice have been tempted to purchase such products from the lowest bidder.

Obviously, the resulting disappointments which tend to discourage the future use of plastic pipe in industry, could have been prevented. And, to quote from Julius Ceasar, "The evil . . . lives after them, the good is oft interred with their bones."

Fortunately, most of the surviving firms have demonstrated their reliability. Much of their efforts has been directed toward building a mature industry. For example, standards are being developed rapidly by the Thermoplastic Pipe Division of the Society of Plastics Industries in conjunction with other standards groups. This program is now in its fifth year.

Pipe suitable for use with potable water now carries a seal of approval of the National Sanitation Foundation. Other hallmarks and further assurances of reliability may be anticipated in the future. It would be unrealistic to expect all members of the industry to support these programs. Presumably a comparable situation exists in other industries.

Fabrication of reinforced pipe is actually simpler than the extrusion of thermoplastic pipe. A product having the general appearance of pipe can be made with very little investment.

It is of interest to note that while more than a score of firms were attempting to produce reinforced plastic pipe five years ago, there are very few firms producing this type of pipe today. One of these firms has already invested over $1,000,000 in its attempt to produce a satisfactory, commercial, reinforced plastic structure.

Comparable observations could be made for the fabrication of plastic linings, flumes, and ducts. Yet it is surprising to report that almost everyone feels qualified to fabricate these materials. The procedure for becoming a plastic fabricator is very simple. One presents the lowest bid, secures the contract and then attempts to learn fabrication techniques. Unforunately, the unsound emphasis placed on initial price rather than on continued satisfactory performance is usually forgotten when the resultant structure is found to be unsatisfactory.

TABLE 3. General Recommendations.

Service	Preferred Plastic
Pipe or small plastic vessels,	
Low-pressure, normal temperature service;	
Water, alkalis, acids	Polyethylene, Polyvinylchloride
Hydrocarbon solvents	Polyvinylchloride
More active solvents	Reinforced epoxy resins
Large plastic vessels;	
Water, alkalis, acids, solvents	Asbestos-furan
Flumes and Ducts	
Water, alkalis, acids, solvents	Polyvinylchloride

Recommendations

It may occur to some that the various problems related to the use of plastics as materials of construction are complicated by the wide variety of materials available. With this in mind, a few useful products and their applications are outlined in Table 3. Omission of any material should not be considered as a condemnation of any specific product.

Plastics as Maintenance Materials

The need for adequate design and skilled labor for the fabrication of equipment in the chemical process industry must be recognized. Nevertheless, the discreet use of plastic materials for temporary repairs, etc., must not be overlooked.

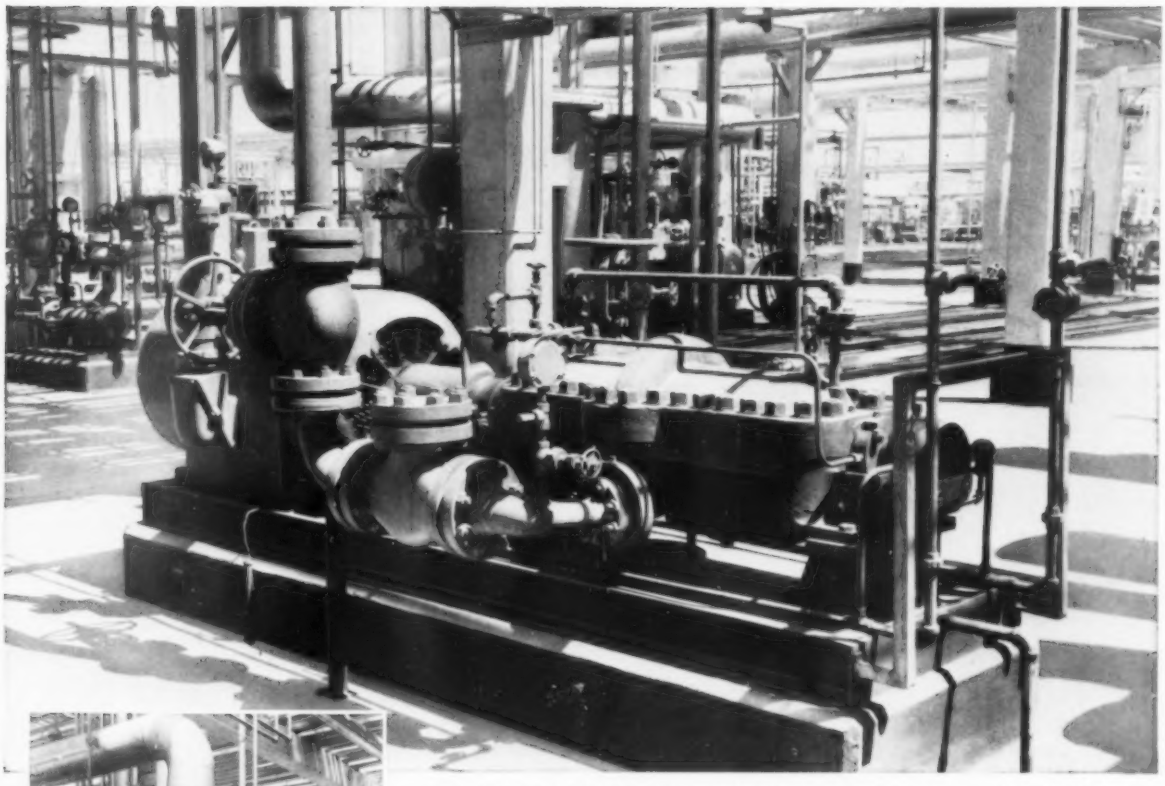
Vinyl plastigels, epoxy cements, polyethylene tape, and polyethylene pipe are extremely versatile materials. They have been used often to prevent shut-downs due to equipment failures.

The judicious use of an epoxy cement may repair a leaking tank satisfactorily. Polyethylene pipe inserted in an acid line may permit a leaking acid line to operate satisfactorily. It is essential to recognize the limitations of these applications, however. Too often these small successes lead to large mistakes.

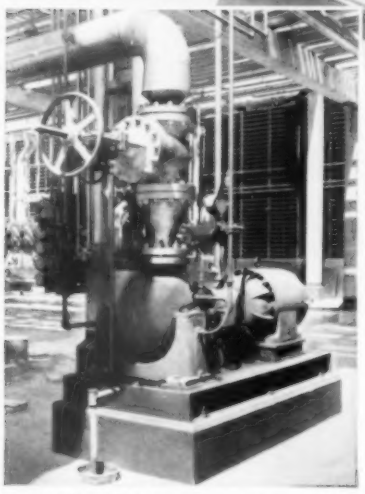
Acknowledgments

The assistance of H. A. Fedderson and P. A. March in the preparation of this article is gratefully acknowledged.

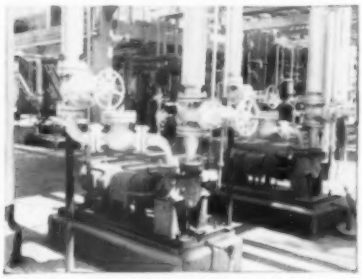
★ ★ ★



Ingersoll-Rand 200-hp Class CNTA reactor charge pump for Rexforming Unit at Cosden Refinery, handling gasoline at 195 gpm.



Ingersoll-Rand Class HFL extractor charge pump handling hydrocarbon liquid at 200 gpm.



Two Ingersoll-Rand Class SFL pumps for No. 2 tower, handling hydrocarbon feed stock at 80 gpm.

CHARGE PUMPS

at Cosden Rexformer Unit

Ingersoll-Rand Centrifugals put the pressure on high-octane gasoline production at Texas refinery

THE Ingersoll-Rand pumps shown here, handling hydrocarbon charge stocks, are but four of the *thirty* I-R pumps serving the new U.O.P. designed Rexformer Unit at the Big Spring Refinery of Cosden Petroleum Corporation.

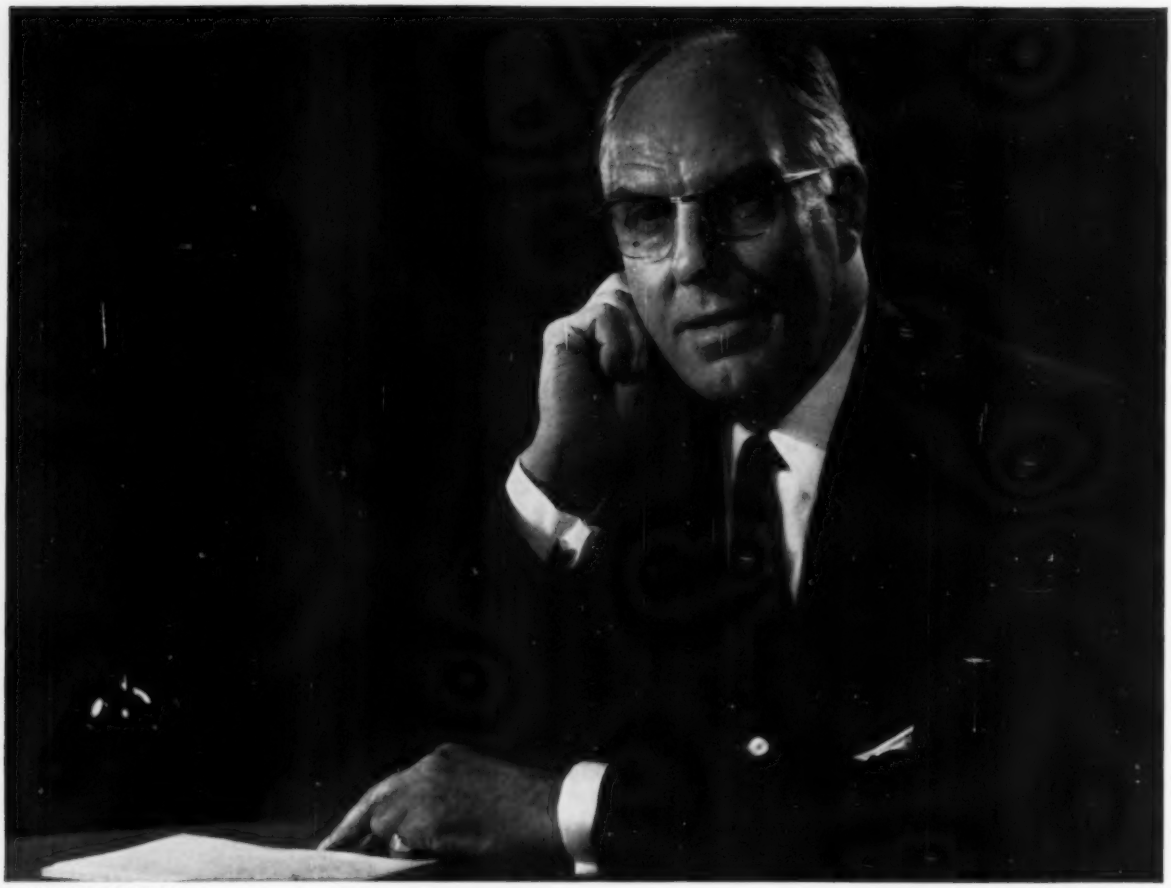
These charge pumps, operating at pressures up to 700 psig, are vital to the entire reforming process. Any failures here could shut down the entire unit. That's why the traditional *dependability* of Ingersoll-Rand pumps is a big asset. Their sustained high efficiency and low maintenance are important *economy* factors, too.

The complete I-R line of centrifugal pumps covers every refinery or process plant application, in types, sizes and capacities to meet every requirement to best advantage. To solve your pumping problems *fast*, just call your nearest I-R Branch Office.

Ingersoll-Rand

10-692 11 Broadway, New York 4, N. Y.

PUMPS • COMPRESSORS • DIESEL ENGINES • AIR & ELECTRIC TOOLS • TURBO BLOWERS • CONDENSERS



G. ALLAN MacNAMARA

Portrait by Fabian Bachrach

"IT'S AGAIN FASHIONABLE TO BE THRIFTY— and 69% of our Soo Line employees are saving regularly through the Payroll Savings Plan"

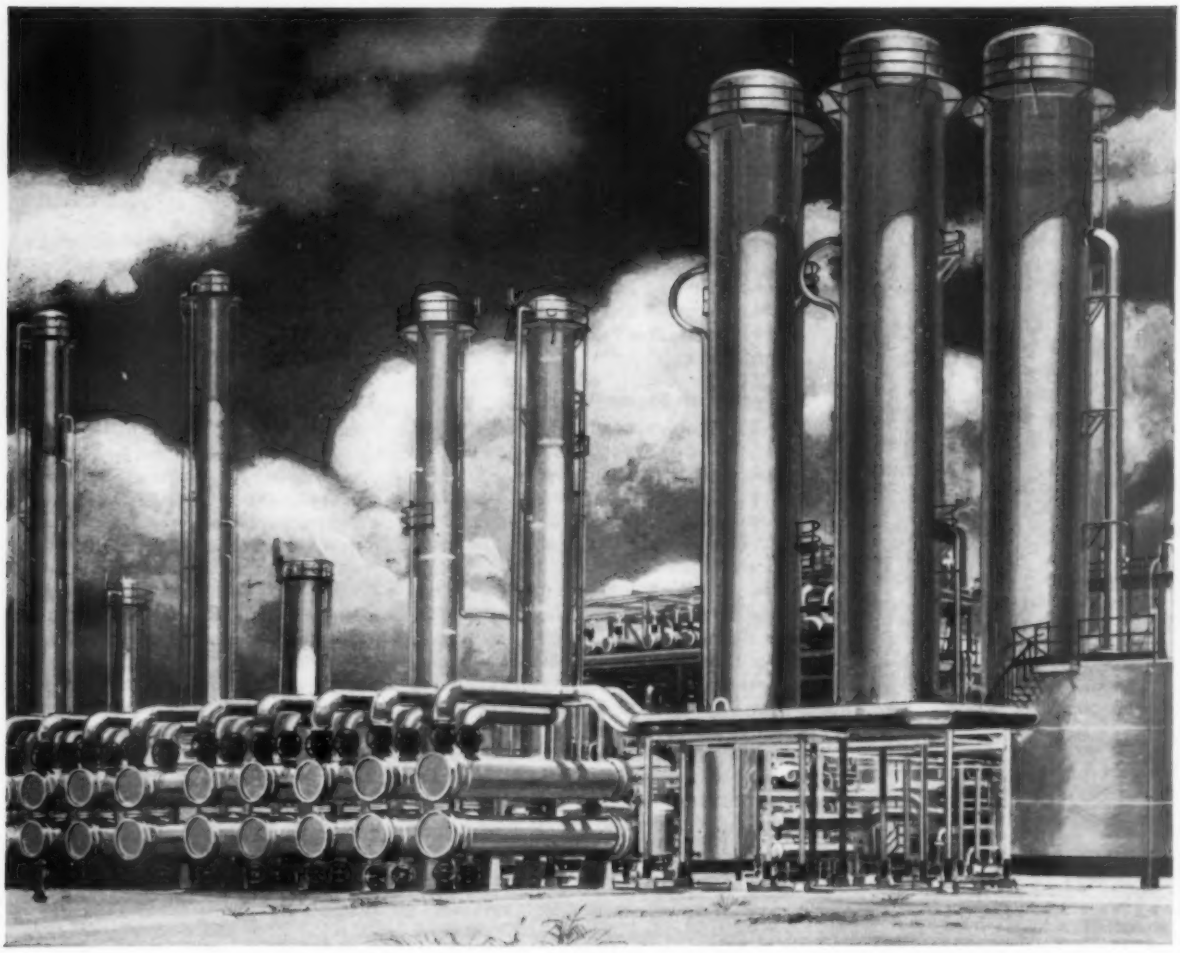
"It's again fashionable to be thrifty, and it is reassuring to note that 69% of our employees on the Soo Line are making regular purchases of U. S. Savings Bonds. Inflation is a complex thing, but here is a simple, direct step every one of us can take to help control the rising price spiral. Our recent company-wide campaign has proved that employees *want to* and *will* practice thrift by buying U. S. Savings Bonds."

G. ALLAN MacNAMARA, *President, Soo Line Railroad*

Individual savings are the bedrock of a sound economy. Today there are more Payroll savers than ever before in peacetime. If employee participation in *your* Payroll Savings Plan is less than 50% . . . or if *your* employees do not now have the opportunity to build for their future through the systematic purchase of U. S. Savings Bonds, your State Director will welcome an opportunity to help. His experience is yours, in setting up a Payroll Savings Plan or in building up enrollment in one already existing. Look up your State Director in the phone book. Or write: Savings Bonds Division, U. S. Treasury Dept., Washington, D. C.

The Petroleum Engineer

THE U. S. GOVERNMENT DOES NOT PAY FOR THIS ADVERTISEMENT. THE TREASURY DEPARTMENT THANKS, FOR THEIR PATRIOTISM, THE ADVERTISING COUNCIL AND THE DONOR ABOVE



COREXIT protects your expensive equipment against internal corrosion *for only a few cents a day!*

Humble's COREXIT is a proven product with years of success in corrosion prevention in the oil and gas industry. Experience proves that COREXIT will provide 98% protection against internal corrosion in natural gasoline plants and natural gas cycling plants.

There are COREXIT formulas specifically designed to assure you almost total protection against internal corrosion in absorption units, distillation units, fractionation towers, vapor recovery systems, Girbotal units, and related heat transfer equipment. COREXIT is compatible with ammonia, and it is often desirable to team COREXIT with this type of neutralizer for complete coverage of a liquid-phase-vapor-phase system.

COREXIT is readily available at Humble wholesale plants throughout Texas and New Mexico.

● *Without cost or obligation, Humble's Technical Service engineers will assist you in solving your corrosion problems. For engineering service or further information on COREXIT, phone or write:*

Humble Oil & Refining Company
Sales Technical Service
P. O. Box 2180
Houston 1, Texas

HUMBLE

HUMBLE OIL & REFINING COMPANY

For information on COREXIT in Illinois, Indiana and Kentucky, write or phone:
Mid-State Chemical Company, Inc.
Mt. Vernon, Illinois

For information on COREXIT in Oklahoma and Kansas, write or phone:
Pet-Chem, Inc.
Mayo Building
Tulsa, Oklahoma

SELECTION OF FURNACE

Part 1. Factors in Tube Selection; Types of Tubing and Strength Properties

Thomas M. Krebs
The Babcock & Wilcox Company, Tubular Products Division

LONG LIFE is the goal for design and operation of heater tubes in refinery and petrochemical service. It must be achieved economically with a minimum of down-time and maintenance. This may be attained by proper selection of tubing with due regard for the factors that affect performance and costs. In general, strength, corrosion resistance, and structural stability of tubing are the primary metallurgical features which influence serviceability.

From the environmental standpoint, the most important factors are those of stress, temperature, time and chemical nature. Economic factors include original tube cost and the costs involved with fabrication and maintenance. Proper blending of these various aspects is necessary to obtain satisfactory and economical service. Since this depends on the combined engineering skills of the furnace designer, tube manufacturer, fabricator, and operator, each must have an appreciation of the factors involved in tube selection and use.

*For example, Babcock & Wilcox Specification A-1.

Types of Steels Used

Choice of heater tubes is most commonly made from a list of 13 steels described by standard seamless tubing specifications of the American Society for Testing Materials shown in Table 1. These include the carbon and carbon-moly steels of A-161 Specification, the chromium-molybdenum steels of A-200 and the stainless steels of A-271.

Additional specifications* are sometimes used to supplement the latter to cover other standard stainless analyses used for the most rigorous heater services. This comparatively short list of steels suffices for nearly every common type of process requirement. This list of steels is the result of an effort by industry to standardize on a relatively small number of alloys with proved capabilities. This course has been beneficial in further concentrating knowledge and experience in a few alloys rather than diffusing it over many.

In selecting and specifying heater tubes, the ASTM Specifications are used with confidence. They describe chemistry and dimensional limits, mechanical test requirements and inspection criteria. Heater tubing to these specifications is supplied in a soft condition to meet the hardness and deformation requirements. These relate primarily to fabrication rather than to the end use. This is common to most tubing specifications for high temperature service because as yet no satisfactory, rapid, correlative test for gaging the performance of steels at elevated temperatures is available. Thus, the specified tensile properties serve mainly as checks and as bench marks for comparison with the large quantities of similar tubing having a long background of successful usage. The fact

TABLE 1. Properties of Commonly

Steel Specification	Carbon Steel A-161		C-.5 Mo A-161		Croloy 1-¼ (1.25 Cr-.5 Mo) A-200		Croloy 2 (2 Cr-.5 Mo) A-200		Croloy 2-¼ (2.25 Cr-1 Mo) A-200		Croloy 3M (3 Cr-1 Mo) A-200		Croloy 5 (5 Cr-.5 Mo) A-200		Croloy 5 Si (5Cr-.5 Mo-1.5 Si)	
Creep Strength[1]	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
800 F	20,000	15,000	29,000	21,000	32,000	22,500	—	—	—	—	—	—	23,500	17,000	—	—
900	10,500	8,500	19,000	12,500	26,500	18,000	19,500	15,000	40,500	22,000	19,500	14,000	15,000	10,000	16,000	10,000
1000	5,000	3,000	10,000	7,000	18,000	11,500	10,500	6,000	14,000	7,500	11,500	7,000	9,000	5,500	8,000	5,500
1100	1,500	1,000	4,000	2,700	7,000	4,000	5,500	3,000	8,000	4,000	7,500	3,700	5,000	3,000	4,800	2,500
1200	—	—	1,500	800	3,800	1,500	3,500	1,200	4,500	2,500	4,200	1,500	2,500	1,500	2,500	1,300
1300	—	—	—	—	2,000	800	—	—	—	—	—	—	1,800	800	1,500	1,000
1400	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rupture Strength[2]	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D
800 F	16,000	11,000	—	—	—	—	—	—	—	—	—	—	—	—	—	—
900	11,500	6,500	39,000	15,000	40,000	30,500	—	—	—	—	29,000	—	25,500	22,500	—	—
1000	7,000	3,000	16,500	6,700	24,000	16,000	15,000	10,500	18,000	14,000	15,000	—	14,000	11,000	12,500	10,000
1100	3,500	1,200	5,500	3,000	10,800	7,000	9,000	6,500	10,500	7,500	8,500	—	7,700	5,500	7,500	5,500
1200	—	—	2,500	1,800	4,000	2,500	4,500	3,000	5,500	3,800	5,000	—	4,200	3,000	4,000	3,000
1300	—	—	—	—	1,500	800	2,000	—	2,500	1,500	—	—	2,500	1,500	2,500	2,000
1400	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1600	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1800	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Tensile Properties[3]	E	F	E	F	E	F	E	F	E	F	E	F	E	F	E	F
RT[4]	47,000	26,000	55,000	30,000	60,000	25,000	60,000	25,000	60,000	25,000	60,000	25,000	60,000	25,000	60,000	25,000
200 F	64,000	39,000	70,000	40,000	68,000	33,000	66,000	39,000	70,000	40,000	68,000	36,000	68,000	28,000	83,000	48,000
400	67,000	35,000	71,000	38,000	70,000	30,000	67,000	36,000	65,000	35,000	61,000	35,000	65,000	26,000	80,000	46,000
600	63,000	29,000	68,000	34,000	70,000	27,000	65,000	31,000	62,000	31,000	57,000	35,000	60,000	24,000	74,000	42,000
800	52,000	23,000	60,000	30,000	67,000	26,000	60,000	24,000	62,000	31,000	58,000	34,000	54,000	21,000	63,000	35,000
1000	30,000	17,000	47,000	23,000	57,000	25,000	50,000	20,000	54,000	30,000	48,000	29,000	44,000	17,000	47,000	25,000
1200	15,000	10,000	28,000	15,000	35,000	16,000	30,000	16,000	32,000	22,000	25,000	21,000	25,000	12,000	24,000	15,000
1400	8,000	3,000	12,000	5,000	13,000	7,000	10,000	7,000	12,000	9,000	12,000	10,000	13,000	7,000	10,000	5,000
1600	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Oxidation Resistance[5]	1050 F		1050 F		1100 F		1150 F		1175 F		1175 F		1200 F		1300 F	
Relative Cost	1.00		1.52		1.98		2.15		2.53		2.58		2.63		2.85	

[1]Creep strength — average stress to cause a minimum creep rate of (A) 1 percent per 10,000 hours; (B) 1 percent per 100,000 hours.
[2]Creep rupture strength — average stress to cause rupture in (C) 10,000 hours; (D) 100,000 hours.
[3]Tensile properties — average tensile strength (E); average yield strength (F).
[4]Room temperature tensile and yield strength shown are minimum specified properties.

TUBES For Refinery and Petrochemical Service

that failures from defective tubing are extremely rare is testimony to the adequacy of the specifications and tube manufacturing processes.

Factors in Tube Selection

Common questions in the selection of heater tubes are whether to use hot or cold finished and average or minimum wall. It can be said with assurance that all these choices are satisfactory. However, it should be pointed out that heater tubes of the heat resisting austenitic stainless steels are supplied only in the cold finished condition. This is done to insure the highest tube quality in these steels.

Carbon, low alloy and intermediate alloy steel heater tubes may be obtained either hot or cold finished at the purchaser's option. Hot finished tubing of these grades has a very long history of satisfactory use and is favored because of its lower cost.

Minimum vs average wall. In the matter of minimum wall vs average wall, this question is primarily one of definition. In minimum wall tubes, the wall is not permitted to be less than the specified minimum thickness. In this case, it is permissible for the wall to be thicker than the minimum by up to 28 percent for hot finished and 22 percent for cold finished tubes. The wall of average wall tubes is permitted to vary both above and below the specified thickness by 12½ percent for hot finished tubes and 10 percent for cold drawn tubes. Thus, there is a difference between minimum and average wall tubes viewed in this sense but none in another.

For example, there is certainly a difference between specifying .400 in. minimum wall and .400 average wall because the wall in the latter could permissibly be as thin as .350 in. with hot finished tolerances. On the other hand, there would be no significant dimensional difference between hot finished tubes specified as .350 in. minimum wall and .400 in. average wall. For all practical purposes, these tubes would be identical both in wall dimensions and method of manufacture.

Selection of tube size is a function of several variables. Tube diameter is based on process throughput requirements and the wall on temperature, pressure, and corrosion considerations. Methods for calculating wall thickness in the design of heater tubes have not been standardized and practices vary with designers and consumers. Normally the wall thickness is designed for a predetermined tube life. It is the sum of the thicknesses required for strength to resist the process conditions and the thickness for corrosion allowance.

Heater tube life is usually governed by the corrosion allowance with the tube being retired when this allowance is expended. The thickness added for corrosion also confers strength; however, it is necessary to have present some minimum wall thickness based on stress calculations and strength con-

Employed Furnace Tubing.[5]

Croloy 7 (7 Cr-.5 Mo) A-200		Croloy 9M (9 Cr-1 Mo) A-200		Croloy 18-8 (TP-304) A-271		Cro 18-8CbTa (TP-347) A-271		Croloy 18-8 Ti (TP-321) A-271		Croloy 18-8 Si (Type 302B Mod.) B&W A-1[6]		Croloy 25-12 (Type 309) B&W A-1[6]		Croloy 25-20 (Type 310) B&W A-1[6]		Steel Specification
A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	Creep Strength[1]
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	800 F
14,000	9,000	33,000	24,500	28,000	18,000	—	—	—	—	—	—	—	—	—	—	900
8,000	5,000	12,000	8,500	20,000	12,000	31,500	27,000	—	—	—	—	—	—	32,500	17,500	1000
4,300	2,500	6,000	3,500	13,000	7,500	23,000	16,500	16,500	11,500	—	—	—	—	23,000	12,500	1100
2,500	1,000	3,000	1,500	8,000	4,200	16,000	9,500	9,500	6,500	—	—	9,500	4,500	15,000	8,000	1200
1,500	300	1,700	800	5,000	2,500	9,500	5,000	5,000	3,000	—	—	5,500	2,000	9,500	5,000	1300
—	—	—	—	3,000	1,500	5,000	2,000	2,500	1,700	—	—	3,000	800	6,000	2,500	1400
—	—	—	—	2,500	1,200	1,700	1,000	1,000	1,000	—	—	1,300	200	3,500	1,500	1500
C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	Rupture Strength[2]
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	800 F
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	900
—	—	20,000	—	27,000	21,000	38,000	33,000	33,500	—	—	—	—	—	26,000	21,000	1000
11,000	8,500	10,500	9,000	17,500	13,000	26,500	21,500	21,000	15,000	—	—	—	—	18,500	14,500	1100
5,000	3,500	5,500	4,000	10,500	7,000	17,500	13,000	12,000	7,500	—	—	13,500	10,000	11,500	9,000	1200
2,500	1,500	2,500	1,500	6,000	4,000	10,500	7,500	6,000	3,500	5,600* (*1350 F)	3,300* —	7,500	4,500	7,500	5,000	1300
—	—	1,200	500	3,500	2,500	5,500	3,800	3,200	1,700	—	—	4,500	2,500	4,500	2,700	1400
—	—	—	—	2,700	1,700	2,500	1,200	2,500	1,300	3,600	2,300	3,000	1,500	3,000	1,300	1500
—	—	—	—	—	—	—	—	—	—	—	—	1,500	750	2,000	750	1600
—	—	—	—	—	—	—	—	—	—	—	—	600	350	500	180	1800
E	F	E	F	RT[4]	E	E		E		E		E		E		Tensile Properties[3]
60,000	25,000	60,000	25,000	RT[4]	75,000	75,000		75,000		75,000		75,000		75,000		RT[4]
79,000	55,000	74,000	34,000	600F	63,000	68,000		75,000		—		85,000		80,000		600 F
76,000	52,000	70,000	31,000	800F	60,000	64,000		66,000		—		79,000		76,000		800
69,000	49,000	65,000	30,000	1000F	55,000	59,000		56,000		—		70,000		72,000		1000
59,000	45,000	58,000	28,000	1200F	47,000	51,000		46,000		51,000		53,000		59,000		1200
43,000	37,000	47,000	23,000	1400F	30,000	36,000		32,000		27,000		37,000		40,000		1400
23,000	20,000	27,000	15,000	1600F	19,000	20,000		18,000		15,000		23,000		22,000		1600
12,000	6,000	13,000	6,000	1800F	7,000	15,000		10,000		7,000		11,000		12,000		1800
—	—	—	—	2000F	—	—		—		—		6,000		7,000		2000
1250 F		1300 F		1600 F		1600 F		1600 F		1700 F		2000 F		2100 F		Oxidation Resist.[3]
2.98		3.79		7.58		10.01		8.89		7.53		10.65		15.26		Relative Cost

[1]Maximum temperature limit for long life under oxidizing conditions.
[2]Similar to A-271 except chemistry.
[3]B&W data.
[4]Data from ASTM STP No. 180, 151, 124.

APEX PETRO-CHEM CORP.
INSPECTOR'S REPORT

TO: Chief Inspector
FROM: Southwest Regional Inspector

I have just witnessed the final hydro tests on Items E-301, E-302, E-304 and E-305, and have approved them for immediate shipment. Western maintained its usual high quality.

Delivery is being made, incidentally, one week ahead of schedule.

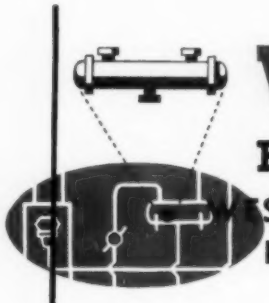
Question: Since heat exchangers fabricated in high standard shops are carefully inspected in accordance with A.S.M.E. Boiler and Pressure Vessel Code, as well as by the manufacturer himself, is it necessary for the customer to spend his own time and money in duplicating this work?

Answer: No, it is not necessary. However, we recognize that all first-line engineering and operating companies are going to make inspections as a matter of policy, THEREFORE . . .

. . . in the case of WESTERN, customer-inspectors are *welcome*, because it is from their reports and discussions that Western has acquired a reputation for the production of high quality heat transfer equipment throughout the petroleum and chemical industries.

Customer-inspectors, in other words, are Western's best salesmen.

Western's "open-door" policy to *all* customer-inspectors is worth investigating.



WESTERN
HEAT EXCHANGERS
WESTERN SUPPLY COMPANY
P.O. Box 1888 – Tulsa, Oklahoma

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

siderations. This prevents failure as the corrosion allowance is depleted.

One cause of variations in wall thickness design practice for heater tubes is considerable difference of opinion among engineers on what constitutes a proper strength basis for safe operation and retirement. At present, some designers and refinery or petrochemical plant engineers follow the ASME Power Boiler Code although it is not mandatory for heater tube service. This code assigns generally conservative allowable stresses or rules for the determination of allowable stresses on the basis of the five strength criteria shown in Table 2. Other engineers use certain of these or modified versions of similar strength criteria (for example, stress to give a creep rate of 1 percent per 10,000 hours), for assigning allowable stress values for a particular alloy.

Because the strength component of wall thickness represents the factor of safety when the corrosion allowance is expended, it is difficult to prescribe general rules which will satisfactorily meet the requirements of all operators. An API committee is working actively to formulate a recommended practice to be used in tube size calculations for heater tube design and retirement. Heller[1] has presented a discussion of this subject.

In spite of disagreement on procedures, basic criteria for strength design are important considerations in the selection and use of tubing in heaters and cannot be disregarded. An explanation of some fundamentals is in order.

Strength Factors In Selection

Temperature plays a part in choosing strength design criteria as well as in the choice of alloys. At temperatures above about 600 F, time exerts an effect on the ability of steel to withstand stress. For the lower temperatures at which convection tubes may operate, allowable stresses are usually based on some fraction of the tensile or yield strength, as for example, those shown in Table 2. For tubing operating at temperatures above about 600 F, creep and creep-rupture strength define ability to resist stress in terms of the environmental parameters — stress, temperature, and time.

Creep strength is defined in terms of the stress to produce some arbitrary rate of elongation in the second stage of deformation of a creep test, e. g., 1 percent in 10,000 hours. There is no clear-cut engineering significance to the practice of designing tubular goods for heater application on the basis of deformation in service; however, over the years a great deal of experience has been developed with plastic creep as an empirical design basis. Consequently, creep data, when viewed against the background of experience in application, provide a valuable gage of a steel's capabilities.

In recent years, increasing emphasis has been placed on creep-rupture data for design and selection of tubing for elevated temperature service. In heater tubing, a liberal amount of creep usually can be tolerated but rupture cannot. Thus, the stress which will cause rupture, or more accurately delay it for an indefinite or predetermined period is also a significant criterion for service.

Creep-rupture tests are similar to creep tests except that higher stresses are used and the time to fracture is determined. Creep-rupture (stress-rupture) data for use in tube application in the process industries is usually extrapolated to 100,000 hours (11.4 years). To minimize errors in extrapolation, both creep and stress rupture tests are preferably carried out to at least 10,000 hours (Fig. 1).

High cost and time consumed in this testing together with relatively recent emphasis accounts for the scarcity of long time rupture data. In an attempt to obtain a better approximation of tubular service, creep-rupture tests of tubing under internal pressure are being conducted in B&W's high-temperature laboratories. In tubular creep-rupture tests, a good correlation with data from tensile-type creep-rupture specimens has been obtained for OD wall ratios common to heater tubes.

Should creep rate or creep rupture be used in tube selection and design?

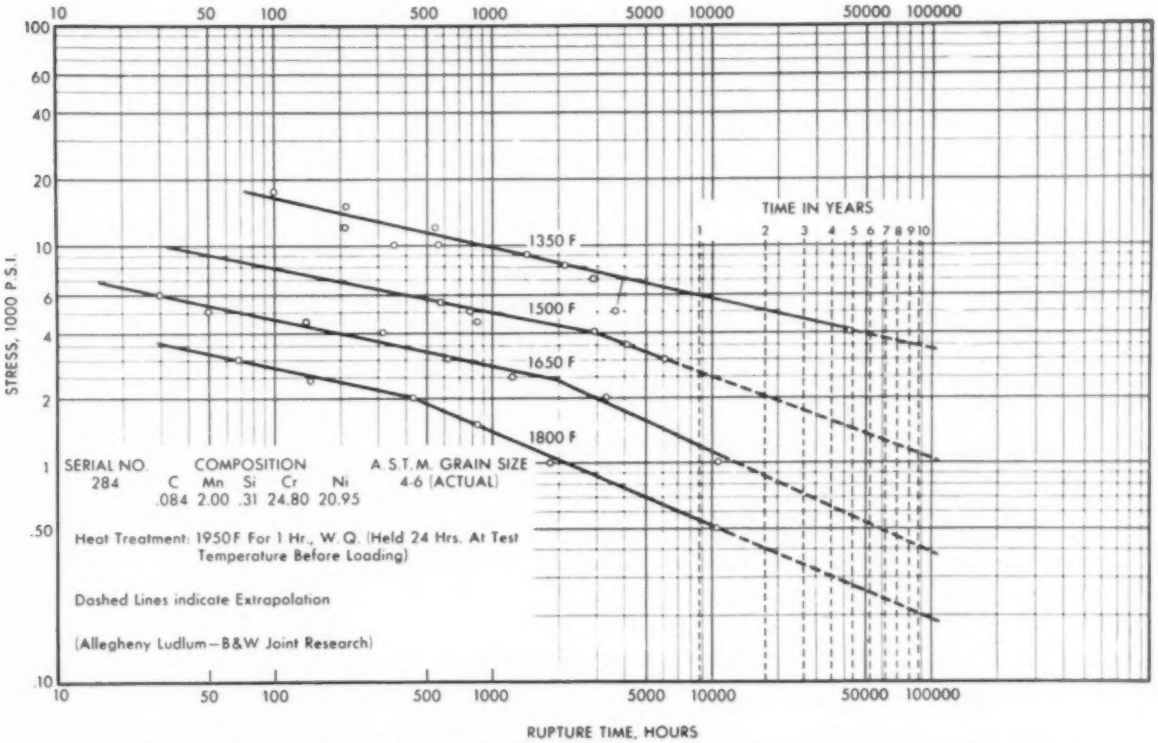

STRESS, 1000 P.S.I.
RUPTURE TIME, HOURS
TIME IN YEARS
1350 F
1500 F
1650 F
1800 F
SERIAL NO. 284
COMPOSITION C .084 Mn 2.00 Si .31 Cr 24.80 Ni 20.95
A.S.T.M. GRAIN SIZE 4-6 (ACTUAL)
Heat Treatment: 1950 F For 1 Hr., W.Q. (Held 24 Hrs. At Test Temperature Before Loading)
Dashed Lines indicate Extrapolation
(Allegheny Ludlum–B&W Joint Research)

FIG. 1. Creep-rupture properties of Croloy 25-20 (Type 310) at various temperatures. Note that extrapolation of data from short-time tests (even up to 3000 hours at 1500 F) would cause considerable error in 100,000-hour creep-rupture value.

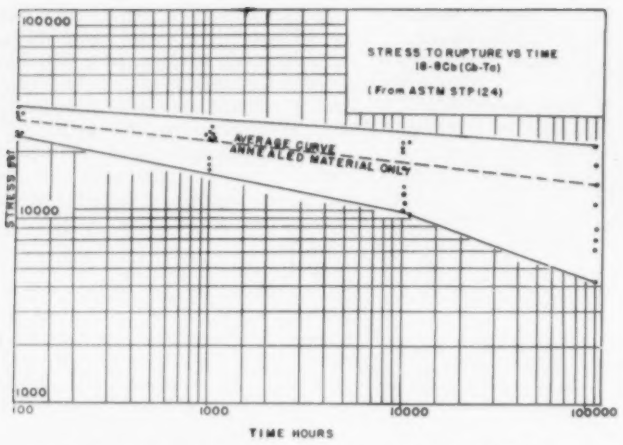


FIG. 2. Scatter band of creep-rupture properties of 18-8Cb at 1200 F is illustrated. Annealed and cold-worked data are included.

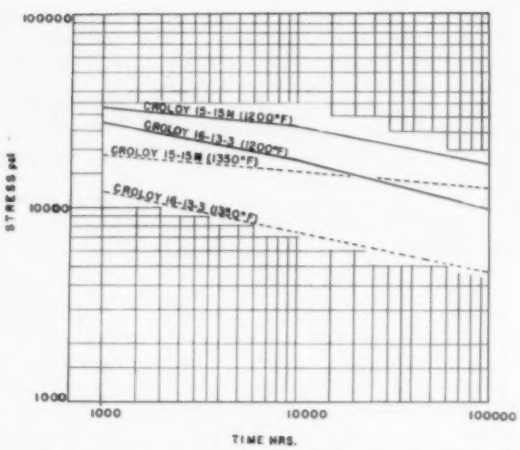


FIG. 3. Creep-rupture for Croloy 15-15N super alloy and standard type 316 stainless. (B&W Data)

TABLE 2. ASME Boiler Code Strength Criteria for Assigning Maximum Allowable Stress Values.

(a) One-quarter of the minimum specified tensile strength.
(b) One-quarter of the tensile strength at temperature as reported by test data.
(c) 62½ percent of the yield strength at temperature as reported by test data.
(d) A conservative average of the stress to give a creep rate of 0.01 percent in 1000 hours (1 percent in 100,000 hours) as reported by test data.
(e) 60 percent of the average or 80 percent of the minimum stress to produce rupture in 100,000 hours as reported by test data.

The answer is both. It is good engineering to get all the data possible on a problem. The science of high-temperature metallurgy is presently too ill-defined to support unswerving opinions. Even short time tensile data have use at low or extremely high temperatures. In connection with the latter, overheating is still the primary cause of tube failures and design must include realistic temperature. Tube selection must be made accordingly. It need hardly be pointed out that tubing of the most perfect quality can only stand a certain amount of abuse.

In general, present design seems to be conservative in the absence of abuse. Tests on 5 Cr-½ Mo tubing after extended service up to 125,000 hours have shown its creep-rupture strength to be unchanged. (This work will be reported by J. F. Ewing at the 1958 Spring Meeting of the API Refining Division.) In connection with retirement after long service, our opinion has always been that there is no substitute for periodic inspection of tubing and that suitability for the next operating period can be judged on the basis of the condition of the tubing with regard to such matters as stress level, wall thickness, scale notches, cracks in hardened layers, etc.

Data on tensile, creep and creep-rupture strength which can be used in selecting tubing for refinery and petrochemical heater service are shown in Table 1. These values were derived from average curves in the high-temperature data compilations of the American Society for Testing Materials.[3, 4, 5]

A word of caution is in order in regard to using average or single point data for design. Elevated temperature test data, like all mechanical test data, have an unavoidable scatter in values. This is caused by variations in chemical composition, heat treatment, fabricating methods or the test itself. Inadequate data may introduce errors of extrapolation. The 100,000 hour creep-rupture strength is particularly susceptible to such errors if testing is of short duration. The conservative engineer will look for scattering when examining data and will give consideration to the low values as well as the average. The band of creep-rupture data plotted from the ASTM compilation[5] for 18-8 Cb austenitic stainless steel in Fig. 2 serves to illustrate possible scatter.

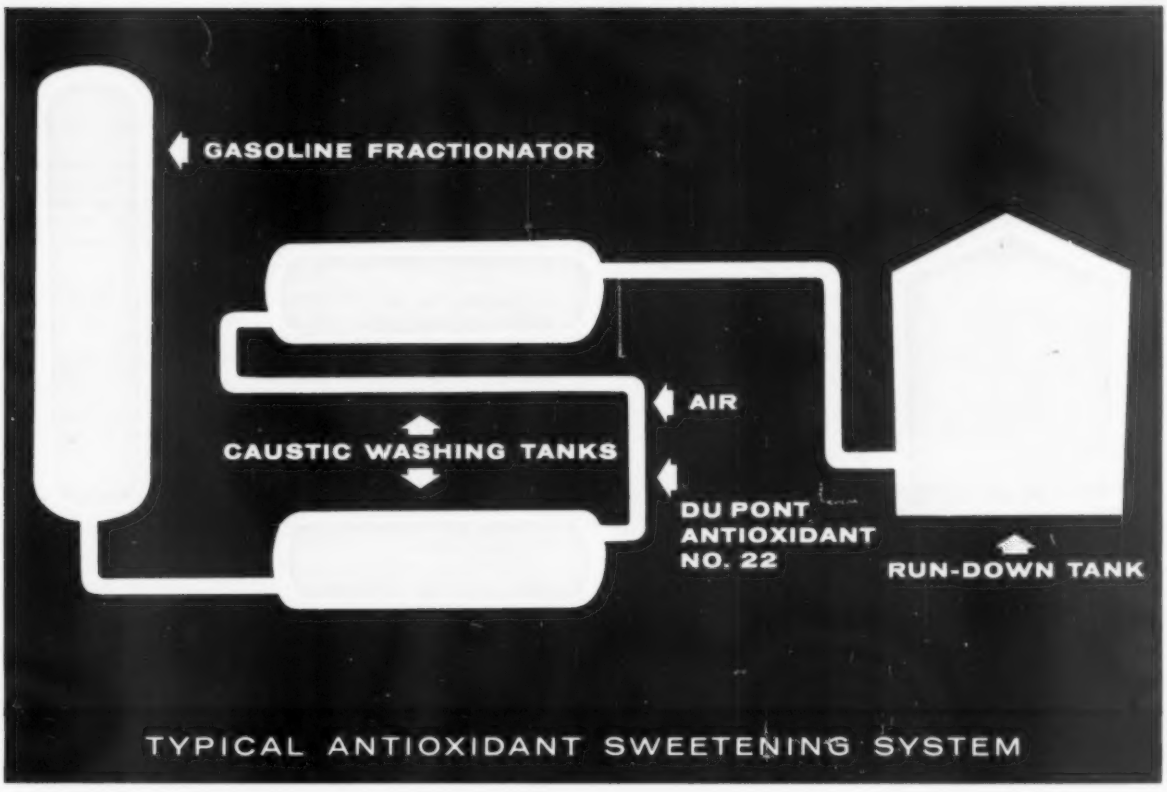
The elevated temperature data in Table 1 illustrate the well-known beneficial effects of alloying in increasing strength over carbon steel. Among these steels, some difference in ranking is obtained depending on whether a creep-rate or creep-rupture criterion is used in the evaluation. In general, the strength at elevated temperatures is increased by molybdenum and small amounts (1 to 3 percent) of chromium. The 2-¼ chrome-1 moly alloy is noted for its excellent strength at elevated temperatures. Superior strength at favorable cost along with the resistance to hydrogen attack characteristic of the intermediate chrome-moly steels is responsible for the wide use of Croloy 2-¼ in catalytic reformer heater service.

Austenitic stainless steels provide a choice of materials with elevated temperature strength as well as corrosion resistance considerably increased over the lower alloys and carbon steels. Use of very high pressures in heater applications has been curtailed in recent years after having risen to about 3000 psi in certain polyforming operations. This curtailment has come with the widespread use of catalysts. There is now demand for tubing materials developing even higher strength than the standard heat resisting (stainless) steels in the field of steam generation for production of electrical power. This has spurred development of iron-base super alloys for tubing such as Croloy 15-15N. This alloy develops maximum strength in the temperature range 1200 to 1500 F. Its superiority to one of the strongest of the common austenitic steels, Type 316, is shown in Fig. 3. Croloy 15-15N is weldable and oxidation resistant to 1500 F. This austenitic alloy is readily hot and cold worked and is available in heater tube sizes. Although the use of catalysts will continue, it seems inevitable that petroleum process demands will eventually require the use of higher temperatures and pressures in heater tubing. Consequently, it should be reassuring to petroleum and chemical engineers to know that alloys will be available when needed to do these jobs.

References

1. J. J. Heller, "Basis for the Design and Retirement of Petroleum Heater Tubes," paper presented at 1956 Annual Meeting, American Society of Mechanical Engineers.
2. J. F. Ewing, paper to be presented at the 1958 Spring Meeting of API Refining Division.
3. Elevated Temperature Properties of Carbon Steels, ASTM Special Technical Publication No. 180.
4. Report on the Elevated Temperature Properties of Chromium-Molybdenum Steels, ASTM Special Technical Publication No. 151.
5. Report on the Elevated Temperature Properties of Stainless Steels, ASTM Special Technical Publication No. 124.

Ed. Note. Part 2, which will discuss corrosion and other factors in furnace tube selection and use, will be in the March issue of The Refining Engineer.



TYPICAL ANTIOXIDANT SWEETENING SYSTEM

Reduce treating costs...

sweeten with antioxidant 22

BY HAROLD J. SCHEULE

With one additive you can take two steps—important ones—in treating gasoline: stabilization *and* sweetening. Du Pont Antioxidant No. 22 (AO-22) is a sweetening agent as well as a stabilizer. And in a single, inexpensive operation both objectives can be attained.

The equipment for sweetening with antioxidants is much less expensive than other types of sweetening equipment. Or, if you prefer to continue using your present equipment, the cost of converting it will be extremely low. The advantage of low operating costs is available either way.

Another important advantage of sweetening with Du Pont AO-22 is that no undesirable chemicals such as sulfur or copper are added to the product. Therefore, the chance of contamination from these elements is eliminated. Also, there is no loss of gasoline or octane number when sweetening is done with AO-22.

Complete line

Since Du Pont supplies a complete line of gasoline antioxidants, our representatives are qualified to advise you on all types of gasoline stability problems.

In addition to Antioxidant No. 22 (N, N'-di-secondary-butyl para-phenylenediamine), the Du Pont line includes gasoline Antioxidants No. 5 (50% N-normal butyl-para-aminophenol) and No. 29 (2,6-di-tertiary butyl-4-methylphenol).

THIS BOOK contains detailed information about all three Antioxidants. Ask any Du Pont Petroleum Chemicals representative for a copy, or write us. E. I. du Pont de Nemours & Co. (Inc.), Room 2420-15 Nemours Building, Wilmington 98, Delaware.

HAROLD J. SCHEULE has for three years been supervisor of the gasoline group. This is part of the Product Application and Service Division of our main Petroleum Laboratory, Carney's Point, N. J.

See the "DU PONT SHOW OF THE MONTH" on CBS

DU PONT

Better Things for Better Living
. . . through Chemistry

Tetraethyl Lead
and other
Petroleum Additives

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Books to Read

Engineering Data Book, *published by the Natural Gasoline Supply Men's Association, 421 Kennedy Building, Tulsa 3, Oklahoma. Pages, 320. Price, $5.*

Newest (seventh) edition of the well-known NGAA Tables, this is a complete manual for design and operation of natural gas processing plants. A new section containing revised NGAA Equilibrium Ratio charts is just one feature. Copies are available through NGSMA member companies or from the association offices.

Catalysis in Practice, *edited by Charles H. Collier, published by Reinhold Publishing Corporation, 430 Park Avenue, New York 22, New York. Pages, 153. Price, $3.95.*

Methods, economics, and problems of catalysis as seen by 10 practitioners in chemical process industries. Topics include choice of catalysts, commercial preparation, fixed and moving bed systems, economics, operating problems, and trends and prospects.

Source Book of Industrial Solvents, *Vol. 2: Halogenated Hydrocarbons by Ibert Mellan, published by Reinhold Publishing Corporation, 430 Park Avenue, New York 22, New York. Pages, 267. Price, $7.*

The chemistry, physical properties, applications of fluorinated, chlorinated, brominated, and iodinated hydrocarbons. Data are selected to present material of greatest practical value. Solvents are classified according to boiling range, properties are tabulated for each solvent.

Process Instruments and Controls Handbook, *edited by Douglas M. Considine, published by McGraw-Hill Book Company, 330 West 42nd Street, New York 36, New York. Pages, 1286. Price, $19.50.*

Operating and design fundamentals of measurement and control systems used in process fields. Subjects include measurement standards, primary elements, measuring systems, indicators and recorders, controllers, timing and programming, telemetering, final control elements, fundamentals of process control, and mathematical techniques. Well-illustrated, with extensive tabular data.

Epoxy Resins—Their Applications and Technology, *by Harry Lee and Kris Neville, published by McGraw-Hill Book Company, 330 West 42nd Street, New York 36, New York. Pages, 305. Price $8.*

A guide to the new field of epoxy resins, including the chemistry of their manufacture and their industrial applications. Extensive tabular and graphical data add to the utility of the text to the theoretician and the user in the field.

Modern Chemistry for the Engineer and Scientist, *edited by G. Ross Robertson, University of California Engineering Extension Series, published by McGraw-Hill Book Company, 330 West 42nd Street, New York 36, New York. Pages, 442. Price, $9.50.*

A collection of lectures by 19 nationally-known chemists, sponsored by the Colleges of Engineering and Department of Chemistry of the University of California. Chapters deal with biochemistry, petroleum chemistry, chemical thermodynamics, isotopic tracers, and other divergent subjects.

Mathematics for Science and Engineering, *by Philip L. Alger, published by McGraw-Hill Book Company, 330 West 42nd Street, New York 36, New York. Pages, 360. Price, $5.50.*

Claimed to contain about 80 percent of the mathematical methods and procedures which an engineer or technician will need to use during his career, chapters deal with arithmetic all the way up to and including mathematical models and circuitry. Algebra, trigonometry, the calculus, and statistics are given comprehensive treatment.

The Industrial pH Handbook, *edited by Thomas J. Kehoe, Process Instruments Division, Beckman Instruments, Inc., 2500 Fullerton Road, Fullerton, California. Pages, 80. Price, $2.*

A review of industrial pH control systems, their principles, application engineering, and equipment. Handbook has about 100 illustrations plus charts, tables, and a bibliography of reference literature.

Elements of Heat Transfer, *Third Edition, by Max Jakob and Geo. A. Hawkins, published by John Wiley & Sons, Inc. 440 Fourth Avenue, New York 16, New York. Pages, 317. Price, $6.75.*

Presented in textbook style, the volume has been revised considerably to introduce new material of recent development. It covers thermal conductivity, of three states of matter; insulating and refractory materials; dimensional analysis of convection, heat transfer by conduction and by radiation, and combinations of these; heat exchange, etc.

Catalysis, Vol. 5, *by Paul H. Emmett, published by Reinhold Publishing Corporation, 430 Park Avenue, New York 22, New York. Pages, 542. Price, $15.*

This volume follows the four earlier works, treats of the Oxo reaction, those of carbon monoxide catalytic synthesis of higher alcohols, hydrogenation of aromatics; hydrogen isotopes in hydrogenation exchange; hydrodesulfurization of liquid petroleum fractions, the last two chapters of special interest to the petroleum industry.

Sixth Symposium (International) on Combustion, *prepared by the Combustion Institute, published by Reinhold Publishing Corporation, 430 Park Avenue, New York 22, New York. Pages, 943. Price, $28.*

This volume presents 125 papers and three panel discussions given before the Institute at Yale University in August 1956, covering the whole gamut of combustion phenomena including structure of laminar and turbulent flames, high speed reactions, combustion chamber flame instability, solid fuel combustion, explosives and propellants, etc.

Dangerous Properties of Industrial Materials, *edited by N. Irving Sax, published by Reinhold Publishing Corporation, 430 Park Avenue, New York 22, New York. Pages, 1467. Price, after December 31, 1957, $22.50.*

This is an exhaustive assembly of data on a great number of industrial materials and their dangerous properties; discusses toxicity, local and systemic, radiation hazard, fire and public health hazards, storage and handling, personal hygiene.

"NEVER MIND HOW THEY GOT THERE! — GET 'EM OUT!"

Perchloroethylene

Licensed by: Scientific Design Company, Inc.

DESCRIPTION: Perchloroethylene, C_2Cl_4, is the principal product from this process. Hydrogen chloride is a by-product. Feedstocks are oxygen-free chlorine and an inert-free hydrocarbon such as natural gas, LPG, or mixtures lighter than butane.

Hydrocarbon feed, chlorine, and recycle streams are mixed and fed to the chlorination furnace. Sustained by heat of reaction, the chlorination proceeds rapidly at 900-1200 F. No catalyst is required. Furnace products are quickly cooled in a quench vessel operated at low temperature.

The liquid quench mixture consists of carbon tetrachloride, perchloroethylene, and aqueous hydrochloric acid. The acid is decanted and sent to the HCl absorber. A blowback column strips the chlorocarbons, with vapor phase sent to a recycle blower.

Carbon tetrachloride is then stripped overhead from the mixture and recycled to the chlorination furnace. Another distillation column further refines the perchloroethylene to high purity product; bottoms from this column are also recycled.

HCl Recovery:

Gases from the quench vessel pass into an absorber where HCl is absorbed in weak acid. Remaining gases are compressed in a recycle blower, with excess chlorine from the absorption system passing through a rectifying column and returned to the furnace.

Strong acid from the absorber is partially stripped to remove dissolved chlorine and other contaminants which are returned to the absorber. A conventional HCl stripping system yields anhydrous hydrogen chloride gas as a process byproduct. Stripper bottoms, approaching the azeotropic composition, are recycled to the HCl absorber.

MATERIALS OF CONSTRUCTION:

Exposed equipment is either corrosion resistant alloy or of non-metallic composition. Ceramic lining or impervious graphite is used for equipment in hydrogen chloride service.

Unique fabrication techniques are required for the chlorination furnace and quench vessel, since they pose stringent problems in mechanical design.

CHEMICAL REACTIONS:

Reactions involved in producing perchloroethylene from several possible feedstocks are as follows:

Methane: $2\ CH_4 + 6\ Cl_2 \rightarrow C_2Cl_4 + 8\ HCl$
Ethane: $2\ C_2H_6 + 10\ Cl_2 \rightarrow 2\ C_2Cl_4 + 12\ HCl$
Propane: $2\ C_3H_8 + 14\ Cl_2 \rightarrow 3\ C_2Cl_4 + 16\ HCl$

COMMERCIAL YIELDS:

Product yields approach 100 percent of theoretical.

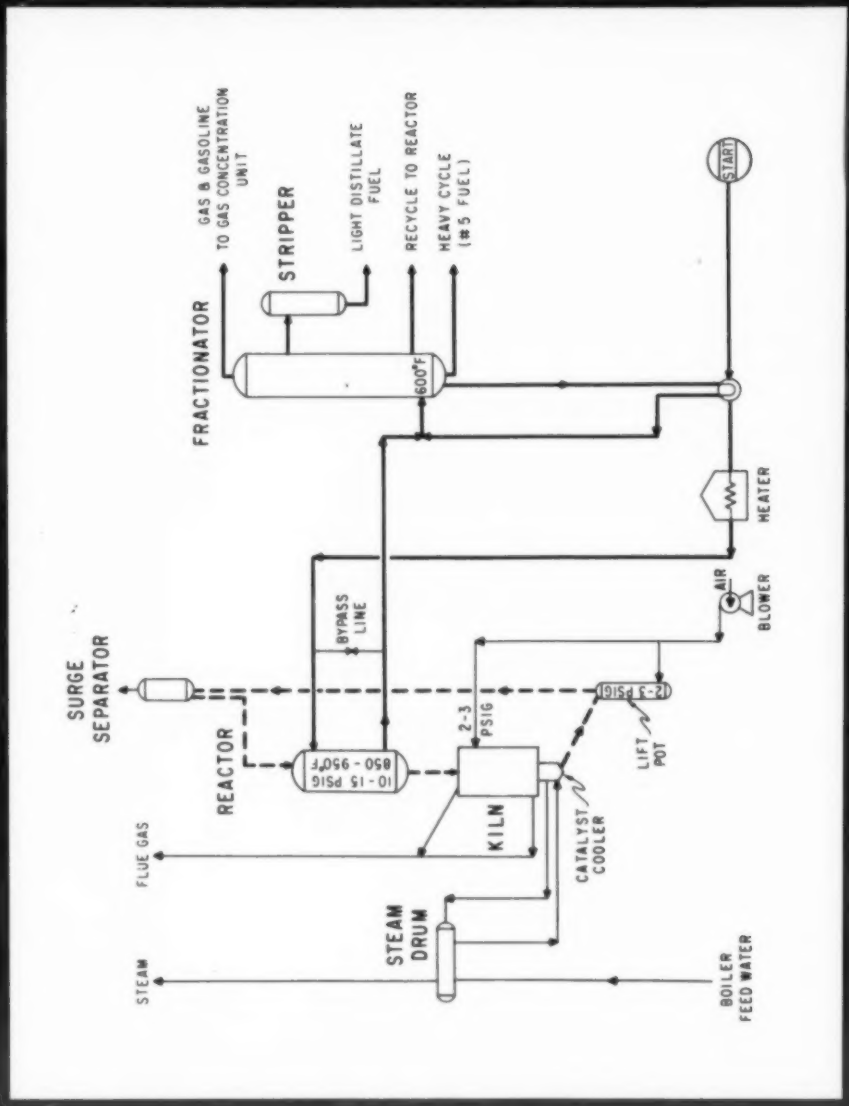
Design for one plant was as follows:
Feed: 45 lb Chlorine
4 lb Propane
Product: 20 lb Perchloroethylene
27 lb Hydrogen Chloride

INVESTMENTS AND OPERATING COSTS:

Must be secured from process licensor.

Airlift Thermofor Catalytic Cracking

Licensed by: Socony Mobil Oil Company, Inc.



Airlift Thermofor Catalytic Cracking

Licensed by: Socony Mobil Oil Company, Inc.

DESCRIPTION: The Airlift TCC process upgrades virgin, thermal, and other stocks, normally in the 650-1150 F boiling range, chiefly to gasoline and distillates.

Preheated feed flows through a packed bed of slowly moving catalyst in the reactor, and is cracked at conditions preselected for almost any product distribution at desired conversion. Spent catalyst is regenerated in an atmospheric pressure kiln, returns via Airlift to repeat the cycle.

Steam is generated in the kiln to cool the catalyst; the unit is a net producer of steam.

Ease of operation is afforded since oil can be bypassed around the reactor without upsetting catalyst flow. And, catalyst inventory is sufficient to smooth out operating upsets. There are 49 Airlift TCC units operating throughout the world; two-thirds of these are licensed to other refiners.

Feedstocks in use vary widely as below:

Distillation — IBP	100°F to 650°F
EP	600°F to 1200°F
Gravity	17 to 40° API
Sulfur	0 to 3 Wt.%
Carbon Residue	0 to 2 Wt.%

TYPICAL FEEDSTOCK AND YIELDS

Feedstock: Mixed Middle East and South American gas oils

Gravity	26.8° API
Sulfur	2.5 Wt.%
Distillation 10%	670°F
50%	872°F
95%	993°F

Commercial Yields: On fresh feed at 54.3% conversion

H_2S, Ethane and lighter gas, % Wt.	3.1
Propane, % Vol.	2.1
Propylene, % Vol.	4.2
Isobutane, % Vol.	4.0
Normal Butane-Butylenes, % Vol.	3.9
Debutanized 400°F End Point Gasoline, % Vol.	39.7
600°F End Point Light Cycle, % Vol.	27.1
Heavy Cycle, % Vol.	18.6
Coke, % Wt.	5.8

PROCESS VARIABLES: Conversions between 40 and 95% have been commercially attained, using ranges of cracking conditions as follows: 0 to 2 recycle to fresh feed ratio, 850 to 950°F reactor temperature, 2 to 8 catalyst-oil ratio, 0.5 to 3.0 space velocity, at catalyst activities between 25 and 32 (CAT-A). Any desired product may be maximized by proper selection of these operating conditions. The interrelation of operating conditions, charge stocks, and product distribution is complicated, and information of this nature should be obtained from the licensor.

SERVICE FACTOR: 95 Percent

UTILITIES	Per B Feed
Steam (Net Production)	125 lb
Power	2.2 kwh
Cooling water (30° rise)	390 gal
Fuel	0.14 MM Btu

Catalyst Requirements

Inventory: Approx. 50 lb per daily B feed

Consumption: 0.1 - 0.2 lb per B feed

OPERATING PERSONNEL — Two to four men per shift.

INVESTMENT

Capacity, B/SD	Erected Cost, $/B*
5,000	230 - 300
10,000	175 - 250
16,500	150 - 210
25,000	120 - 180

*Excludes gas concentration facilities

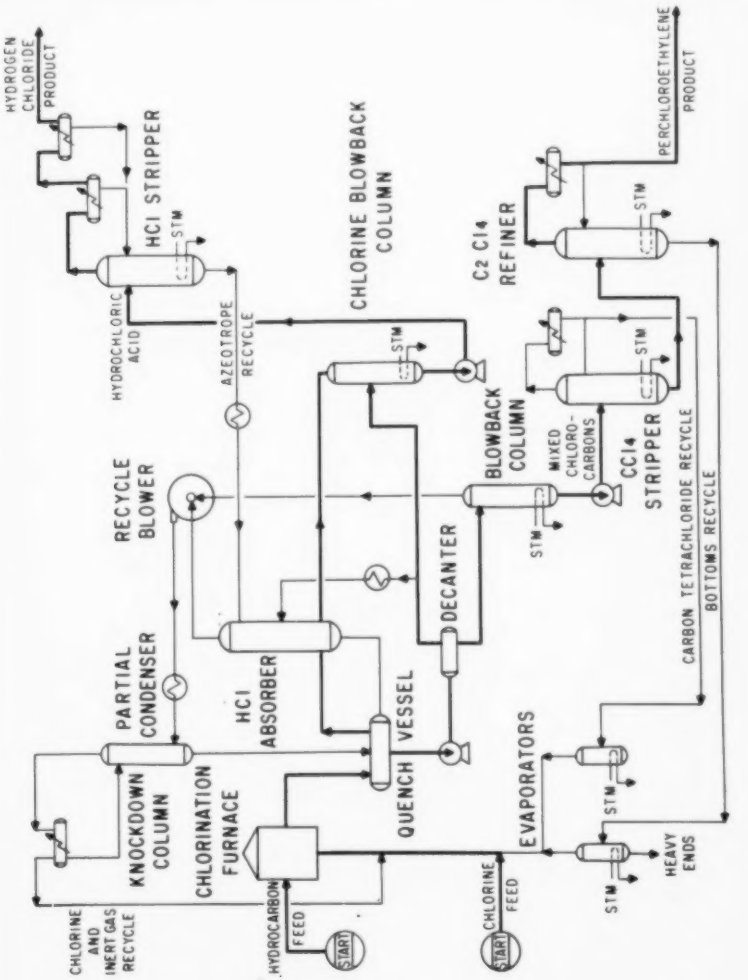
ANNUAL MAINTENANCE

Materials and Supplies: Approx. 1.5% original investment.

Maintenance Manpower: Not higher than 1.8 yearly manhours per BPD feed.

Perchloroethylene

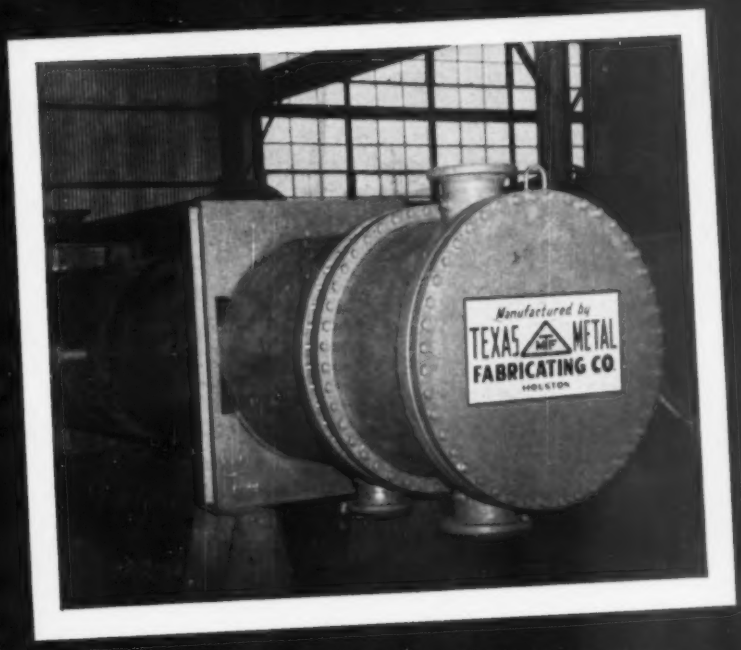
Licensed by: Scientific Design Company, Inc.



The Refining Engineer's **Process Notebook**

HEAT EXCHANGERS

FOR THE PETROLEUM, CHEMICAL, AND PROCESS INDUSTRIES



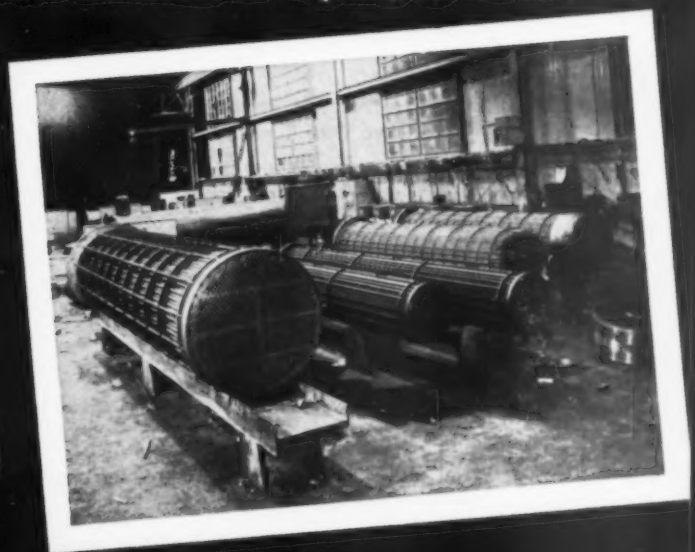
DESIGN • REPAIR • FABRICATION

Your inquiries are cordially invited.

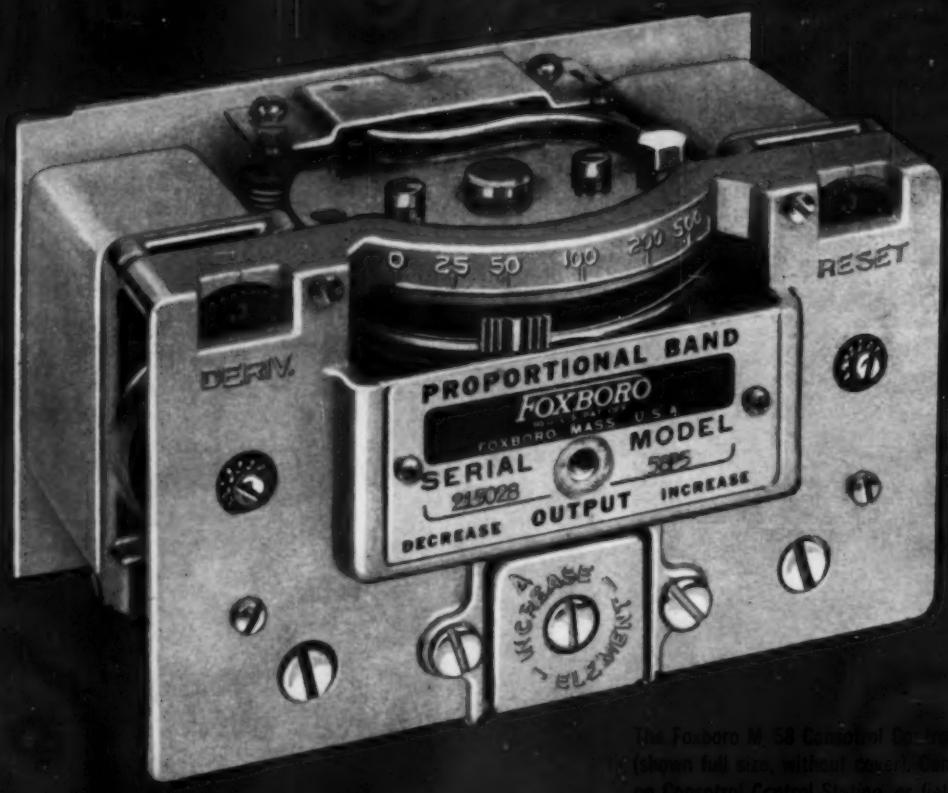
MTF

TEXAS METAL FABRICATING CO.
BOX 7567 - HOUSTON 7, TEXAS

API-ASME AND ASME CODE CONSTRUCTION



BOTTOMS RECYCLE



The Foxboro M/58 Consotrol Controller (shown full size, without cover) can be panel-mounted on Consotrol Control Station or field-mounted.

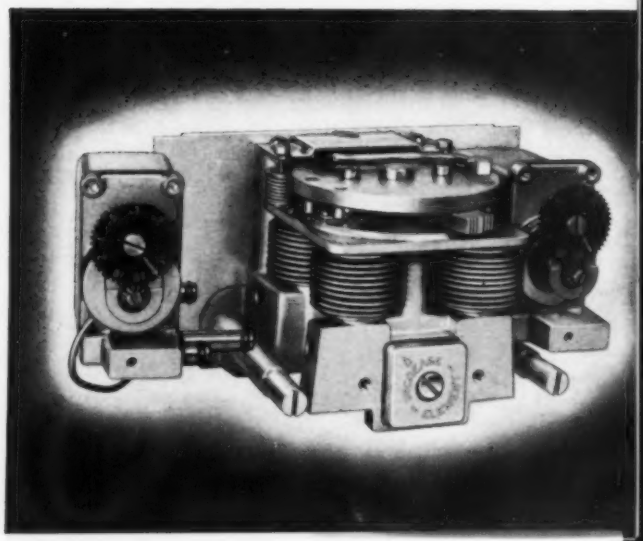
THE FOXBORO M/58 CONSOTROL

The M/58 Controller's Revolutionary Floating Disc System

Here's the exclusive Foxboro design development that gives M/58 Control its unique versatility, precision, and stability. The floating disc and matched bellows assure uniformly high controller sensitivity and pin-point control action, even at widest settings of the proportional band. Lever-set proportional band adjustment is calibrated to 500%.

Component Construction Gives Unrivaled Versatility

Not only is the complete controller easily detachable as a unit, but also, each component is a "plug-in" unit. For example, reset plugs in at right as shown; derivative, similarly, at left. All 4 control actions, with 2 reset ranges, are available and easily adjustable to widest variations in operating conditions. Proportional action from 1 to 500% quickly set by lever.



Outperforms all other controllers !

...the controller with the FLOATING DISC

If you think this claim is exaggerated, just put a Foxboro M 58 Consotrol* Controller on your process. The tougher the job, the more it will outperform other controllers! Or ask any present user . . . many of the largest, most progressive petroleum and chemical processors are using hundreds of these instruments. They will unhesitatingly confirm that this exclusive Foxboro development has put their processes "on stream", automatically and smoothly from the control room, without false starts or confusion.

The M 58 Controller can do the same for your process. The flexibility of its control functions makes it readily adaptable to *all* processing techinques. All four actions are available, with two ranges of reset . . . all are easily adjustable to the most widely varying operating conditions. For example, reset and derivative functions plug in . . . proportional action from 1 to 500% can be quickly set by a lever. And calibration is a simple zero adjustment!

Get full details on this simple, truly "universal" Controller. Write for Bulletin 13-19 and ask your Foxboro Field Engineer for a demonstration. **The Foxboro Company, 642 Neponset Ave., Foxboro, Mass., U.S.A.**

*Reg. U.S. Pat. Off.

FOXBORO **CONSOTROL INSTRUMENTS**

Reg. U.S. Pat. Off.

quickly set by lever.

Why Suffer with Sulfur?

Less sulfur in the refinery stream means less corrosion and gum formation in process equipment . . . lower investment costs . . . less contamination of catalysts . . . less antagonism toward TEL . . . improved product odor, color, and stability . . . more profit in many ways for both the refiner and marketer.

Kellogg has the economic answer to high sulfur crudes. Working closely with the refiner's engineers, as it has done with those of leading oil companies on the East and Gulf Coasts—as well as in England, Belgium, France—Kellogg can design a unit to remove harmful sulfur compounds to almost any degree desired. In one typical instance, weight per cent was reduced from 0.84 to 0.08 in catalytic gas oil, and from 0.66 to 0.05 in furnace-oil distillate.

Optimum investment and operating costs are assured through designs that utilize selectively lower pressures, reduce the use of costly alloys such as 18-8, and lower the consumption of high pressure hydrogen.

Kellogg desulfurization units can be engineered to treat virgin streams of naphtha, kerosene, gas oil and other fuels, and cracked stocks of similar boiling ranges. Or units can be designed to operate simultaneously on streams from the topping and cracking units. Where desired, the design can include equipment to recover the sulfur as a salable by-product. Your inquiries will receive prompt attention.

REFINERY PROCESS DIVISION

The M. W. Kellogg Company

711 THIRD AVENUE, NEW YORK 17, N. Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Co. Ltd., Toronto • Kellogg International Corp., London • Kellogg Pan American Corp., N.Y. Societe Kellogg, Paris • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas

M KELLOGG W

Reg. U.S. Pat. Off.

POWELL

world's largest family of valves

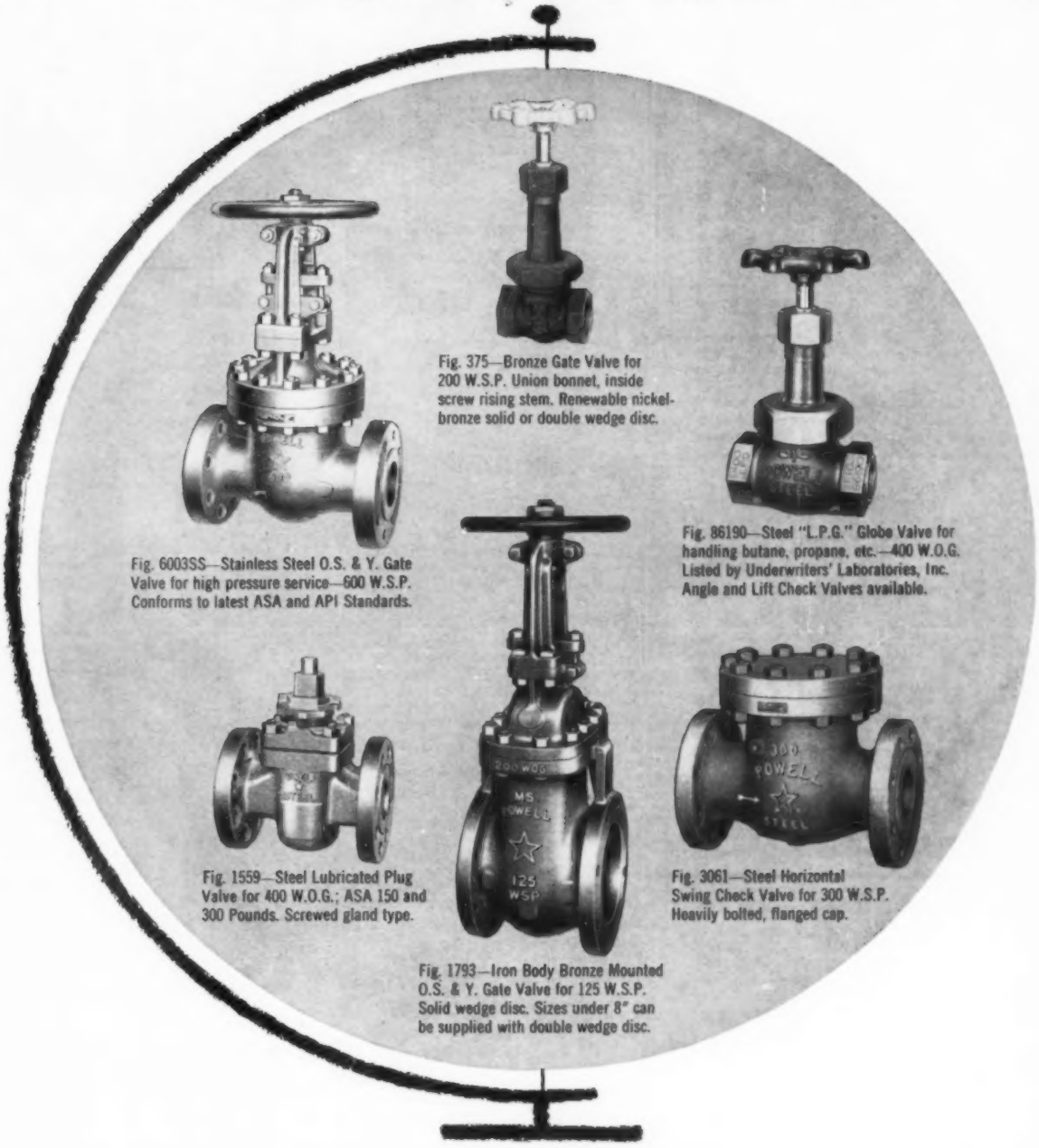


Fig. 375—Bronze Gate Valve for 200 W.S.P. Union bonnet, inside screw rising stem. Renewable nickel-bronze solid or double wedge disc.

Fig. 6003SS—Stainless Steel O.S. & Y. Gate Valve for high pressure service—600 W.S.P. Conforms to latest ASA and API Standards.

Fig. 86190—Steel "L.P.G." Globe Valve for handling butane, propane, etc.—400 W.O.G. Listed by Underwriters' Laboratories, Inc. Angle and Lift Check Valves available.

Fig. 1559—Steel Lubricated Plug Valve for 400 W.O.G.; ASA 150 and 300 Pounds. Screwed gland type.

Fig. 3061—Steel Horizontal Swing Check Valve for 300 W.S.P. Heavily bolted, flanged cap.

Fig. 1793—Iron Body Bronze Mounted O.S. & Y. Gate Valve for 125 W.S.P. Solid wedge disc. Sizes under 8" can be supplied with double wedge disc.

FOR EVERY FLOW CONTROL PROBLEM Powell offers more kinds or types of valves, available in the largest variety of metals and alloys, to handle every flow control requirement. Your local valve distributor will be glad to tell you all about them. Or write to us for the full facts.

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

Here's proof of the solubilizing power of FOA-2

Du Pont Fuel Oil Additive No. 2 has long been known as an exceedingly effective fuel oil stabilizer, sludge dispersant and solubilizer. These qualities have been repeatedly demonstrated in field performance, and now the solubilizing power of the additive can be demonstrated in the laboratory as well.

The demonstration is quite simple and can be made with no more equipment than a heat source (steam bath) and two small vials of fuel. The fuel is kerosine with a small amount of benzene containing dissolved sludge. FOA-2 is added to one of the fuel samples; then the benzene is boiled off of both samples. The time-lapse pictures at the right tell the story.

How FOA-2 solubilizes

The photos show that at the beginning sludge is soluble in the fuel, becoming insoluble only when the aromatic solvent portion (benzene) is removed. The right-hand bottle shows that FOA-2 keeps the sludge soluble, whereas it gradually precipitates in the bottle at left.

FOA-2 is a long-chain polymer with a critical balance between polar and oil-soluble groups. The polar groups are attracted to non-hydrocarbon constituents or residue particles, and the soluble groups maintain good oil solubility of the combination.

FOA-2 *stabilizes* fuel by preventing interaction of non-hydrocarbon constituents or residue formers in the fuel. It *solubilizes* some residues which are just slightly insoluble, and *disperses* other residue particles which are quite oil-insoluble.

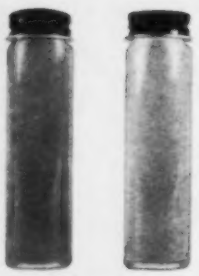
Benefits of the additive

These three properties of Du Pont Fuel Oil Additive No. 2 keep oils free flowing . . . devoid of sludge which could cause clogging of heating systems.

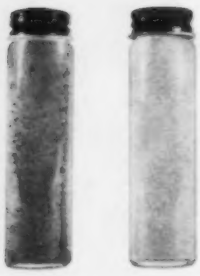
They are responsible also for FOA-2's solution of the incompatibility problem. The sludge likely to precipitate when oils are mixed does not form if sufficient FOA-2 is present; 30 lb./1,000 bbl. is usually enough to prevent incompatibility.

The third important function of the additive is its cleansing of systems already fouled with sludge. This saves the costs of downtime and of having systems cleaned manually.

1. 10:30 a.m., September 23, 1957: These bottles both contain 99% kerosine, 1% benzene and a small amount of sludge (15 mg/100 ml) which is soluble in the fuel blend. To the bottle at right 0.01% of Du Pont FOA-2 has been added. This is the proportion recommended for protecting fuel oils (30 lb./1,000 bbl.).

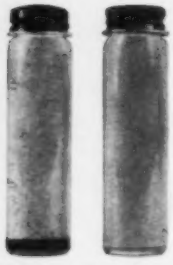


2. 10:42 a.m., same day: The samples have been heated for 10 minutes in boiling water to evaporate the benzene. Sludge is already starting to appear in the bottle at left, not in bottle at right.



3. 11:42 a.m., same day: Note in cut 3 agglomeration of insoluble sludge particles at left, and clarity of FOA-2 protected oil at right.

4. 1 p.m., same day: Some sludge has settled to bottom. Solution at right remains clear.



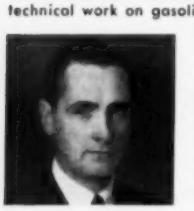
5. 10:30 a.m., next day: Most of the small sludge particles in left-hand bottle have now settled. After 24 hours, FOA-2 protected oil still shows no sign of sludge precipitation, and will continue clear almost indefinitely.

New book about FOA-2

We recently published a comprehensive 28-page book about FOA-2. All the basic information you will need is included—properties, composition, use concentrations, handling and addition methods, and performance testing data. Ask any of our representatives for a copy, or drop us a line.

* * *

WILLIAM T. ROBINSON is head of the group at the main Du Pont Petroleum Laboratory engaged in technical work on gasoline and fuel oil additives. For the past five years, he has been closely associated with the development and application of Du Pont FOA-2. In addition to his activities at the Laboratory, he has worked closely with refiners on the effective use of this additive.



E. I. DU PONT DE NEMOURS & CO. (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

SEE THE "DU PONT SHOW OF THE MONTH" ON CBS

DU PONT

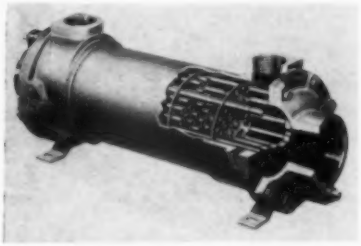
Better Things for Better Living
. . . through Chemistry

Tetraethyl Lead
and other
Petroleum Additives

New Refining Equipment

BCF Exchangers Redesigned

An expanded line of Type BCF exchangers, with performance, new design features and new materials is now available at lower prices. The 1958 BCF is offered in 46 sizes; 1, 2, and 4 pass designs; and 1.2 to 124 sq ft of heat transfer surface.



The line embodies numerous improvements including: New baffle structure with flanged lip at each tube hole and around outer edge to give tighter tube fit and improved thermal characteristics; stamped steel feet movable in three positions around hubs; hubs relieved under connections for unrestricted flow; corrosion resistant copper alloy core assembly and rugged cast iron bonnets. Design is for cooling lube oil, jacket water, hydraulic and other fluids, as well as many process heating applications. *Harold Warner Company.*

Circle number (41) on reply card.

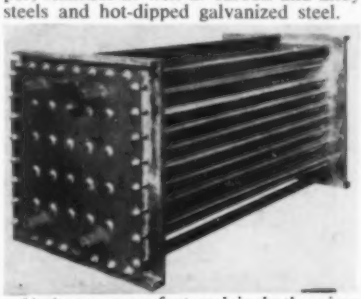
High Shock Resistant Pyroceram Brand Tubing

Tubing, in diameters ranging from ⅛ to ¾ in. will be available in quantity after the first of the year for broad industrial applications. The tubing is pure white and opaque, with the thermal shock resistance equivalent to that of fused silica. Flexural strength of abraded Pyroceram Code 9608 tubing is 17,000-23,000 psi. Pyroceram tubing in heat exchangers would permit higher rates of heat flow per unit area, allow higher operating pressures, and considerably lessen any chance of damage to the unit by abrasive particles. *Corning Glass Works.*

Circle number (42) on reply card.

New Metals for Heat Exchange Coils

Niagara Blower Company announces a new service in the manufacture of coils for various heat exchange duties in process industries. A complete range of choice is offered in the metals from which these coils are made, including aluminum, copper, stainless as well as carbon and alloy steels and hot-dipped galvanized steel.



Coils are manufactured in both prime surface and extended surface types. Coil types include series flow, serpentine coils, parallel flow coils with special headers, fully cleanable coils, variously partitioned coils, and coils with bends to various radii. Coils for pressures up to 3000 lb are also available. *Niagara Blower Company.*

Circle number (43) on reply card.

New Line of Small Size Ball Valves

A new line of small size flanged "double-seal" ball valves has been announced by Jamesbury Corporation. Smaller sizes in ball valves with standard flanges have been added to their line to meet increasing demand for design.

Features detailed are unique "unit-body construction," positive shut-off, low torque over complete pressure range from vacuum to full rated pressure high flow capacity with minimum friction loss, and seats and seals which are interchangeable and replaceable. *Jamesbury Corporation.*

Circle number (44) on reply card.

for leakproof, pressure-tight connections

use TiteSeal®

SEALING COMPOUNDS

Heat and vibration-proof, non-solvent, will not shrink, crack or crumble. Makes all assemblies leak-proof and pressure-tight. Prevents rust, corrosion, joint seizure.

7 BASIC BLENDS

LIQUID WRENCH®

The super-penetrating rust solvent

LOOSENS rusted bolts, nuts, screws, 'frozen' parts

Liquid Wrench works *fast*...yet is absolutely safe for all metals and alloys.

2171

At Industrial, Automotive, Hardware, Plumbing Jobbers

SOLDER SEAL

RADIATOR SPECIALTY CO.
Charlotte, North Carolina

For UNIFORMITY

in ALUMINUM CHLORIDE make yours SOLVAY

Uniformity of product is one of the many sound reasons for specifying SOLVAY Aluminum Chloride. Quality, service, dependability, purity are other important considerations.

Write for literature, prices, specific information.

SOLVAY®

SOLVAY PROCESS DIVISION

Allied Chemical

ALLIED CHEMICAL & DYE CORPORATION
61 Broadway, New York 6, N. Y.

BRANCH SALES OFFICES

Boston · Charlotte · Chicago · Cincinnati · Cleveland · Detroit · Houston · New Orleans · New York · Philadelphia · Pittsburgh · St. Louis · Syracuse

So SIMPLE
We Can
Adapt It
to ANY
LIQUID LEVEL
CONTROL JOB
A sleeve, raised and lowered within a non-magnetic tube, attracts or releases an Alnico magnet attached to a mercury switch. Basically, this is Magnetrol.
MAGNETROL

AS DEPENDABLE AS MAGNETIC FORCE ITSELF

● No matter how specialized the liquid level control application, adapting Magnetrol to meet it presents no problem. Whether it's for high pressures, high temperatures, corrosive liquids or any other condition, a few "standard" modifications and the job is done! Operation is so simple no changes in basic design are needed. That's why Magnetrol "fits" practically any application — why "specials" are so often standard with us.

Because of the utter simplicity and dependability of its magnetic principle, Magnetrol has *infinite operating life.* There are no wearing parts to get out of order.

Magnetrols are available for controlling level changes from .0025-in. to 150-ft., with single or multi-stage switching. Our experienced engineering staff is at your service.

MAGNETROL, Inc.

WHY NOT MAIL THE COUPON — NOW

Magnetrol, Inc., 2121 S. Marshall Blvd., Chicago 23, Illinois

Please send me catalog data and full information on Magnetrol Liquid Level Controls. 7

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

New Refining Literature

Meter Houses Described

Weatherproof meter houses is the subject of a new catalog published by Moran Furnace and Sheet Metal Company. The 12-page catalog gives specifications and construction features on the complete line of houses, including Moran's standard, multi-door, horizontal, portable walk-in, utility, indicating or recording types, as well as their verticle plant, custom built and cycling meter houses. The catalog is fully illustrated with photographs and diagrams, and gives full details on installation. *Moran Furnace and Sheet Metal Company.*

Circle number (45) on reply card.

Brochure on 2000 F High Temperature Insulation

H. I. Thompson Fiber Glass Company has made available a bulletin on their fibrous silica insulation material. Named "Refrasil," material is extremely light in weight and is made in a variety of physical forms. Blanket pre-formed and wrap-around installations are now in use in refineries for high temperature protection of valves and control equipment, and numerous other applications. Brochure includes chart and data on insulation for temperature ranges from −300 to +3000 F. *H. I. Thompson Fiber Glass Company.*

Circle number (46) on reply card.

How to Get a Filter Area Calculator

A new filter area calculator working on the slide rule principle is now available. Pocket size, the calculator makes possible rapid determination of square feet of filter area required in liquid-solids separation. On one side of the calculator, required area is given in terms of filtration rate. On the reverse side, required filter area is calculated on the basis of cake capacity. The greater of the 2 area requirements obtained is the square feet of filter area to be used. *Niagara Filters Division, American Machine and Metals, Inc.*

Circle number (47) on reply card.

pH Equipment Brochure

Beckman/Process Instruments announces the availability of a new 8-page brochure, "Beckman Industrial pH Equipment." Bulletin 5400 gives detailed descriptions and specifications for all Beckman industrial pH instruments, electrodes and accessories. The brochure is profusely illustrated with photographs and detailed drawings. *Beckman/Process Instruments Division.*

Circle number (49) on reply card.

Humidity and Temperature Instrumentation Catalog Available

A new 6-page catalog describing relative humidity and temperature instrumentation is now available from Serdex, Inc. Design and construction details are provided for a complete line of humidity indicators, recorders and controllers. Accessory photographs and descriptions are included. *Serdex, Inc.*

Circle number (49) on reply card.

Tray Type Deaerator Removes Gases from Boiler Feed Water

Allis-Chalmers tray type deaerator for effective removal of corrosive gases from boiler feed water is described in a new bulletin. Available in sizes with an effluent capacity of from 18,000 lb per hr to more than 2,000,000 lb per hr, the deaerator is constructed by finest welding techniques on plate thickness calculated on 30 psig ASME bases minimum plus 1/16-in corrosive allowance. The bulletin includes a description of the cycle of operation of the tray deaerator, 6 typical storage arrangements, and has a table of standard tray deaerator data. *Allis-Chalmers Manufacturing Company.*

Circle number (50) on reply card.

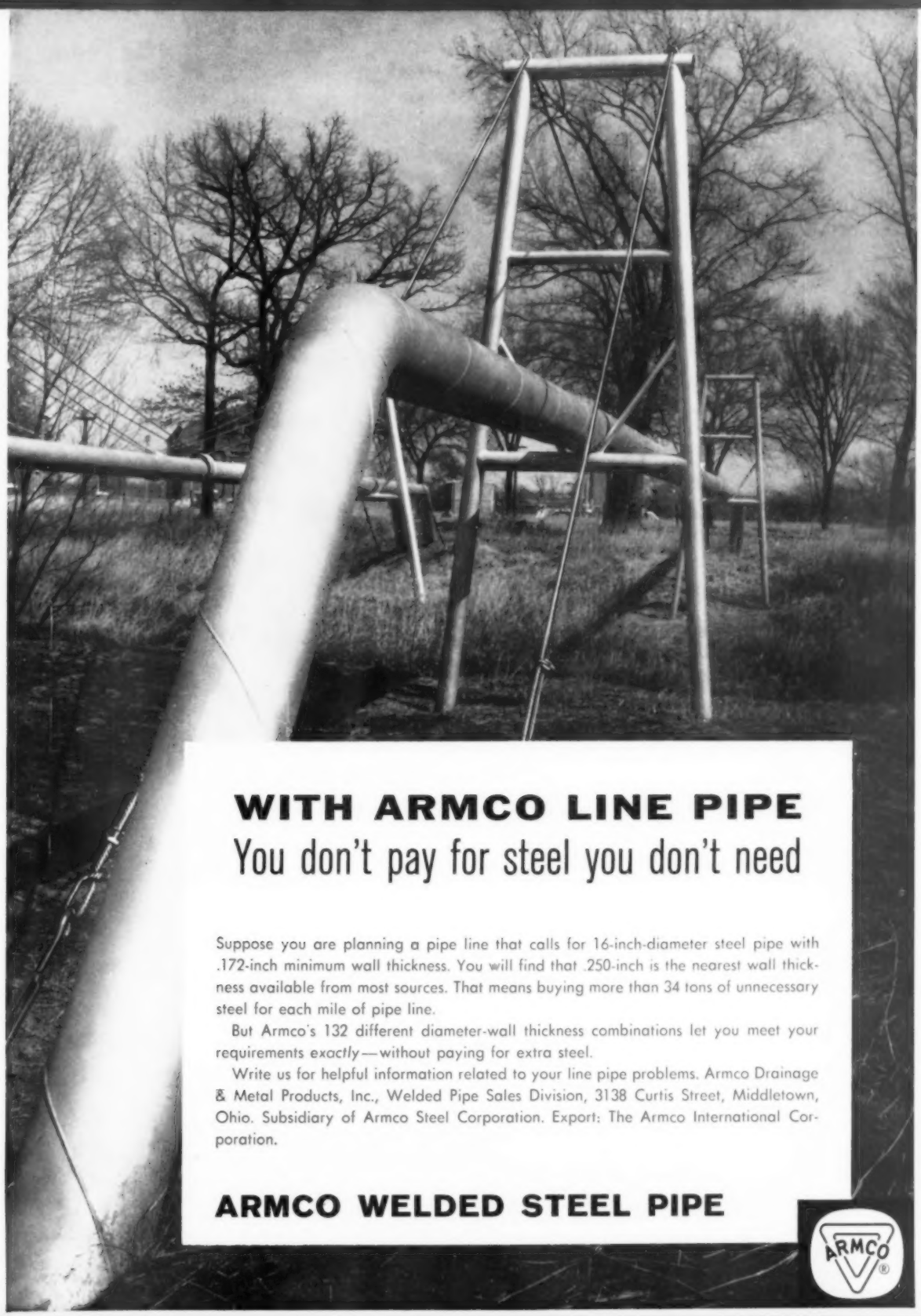
Thinking About Writing a Paper or Article?

"How to Write Better Technical Articles" has been reprinted by *The Petroleum Engineer* and is available to all readers at no charge. This 3-page article, written by John L. Kent, chief of Consolidated Electrodynamic's editorial bureau, shows how material should be organized and presented, and it contrasts basic factors in 4 forms of writing.

Circle number (51) on reply card.

the Pipeline Engineer

Oil..Gas Products Pipelining



WITH ARMCO LINE PIPE

You don't pay for steel you don't need

Suppose you are planning a pipe line that calls for 16-inch-diameter steel pipe with .172-inch minimum wall thickness. You will find that .250-inch is the nearest wall thickness available from most sources. That means buying more than 34 tons of unnecessary steel for each mile of pipe line.

But Armco's 132 different diameter-wall thickness combinations let you meet your requirements *exactly*—without paying for extra steel.

Write us for helpful information related to your line pipe problems. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 3138 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.

ARMCO WELDED STEEL PIPE

ARMCO®

From the day we produce them . . .

. . . till the day you apply them . . .

PITT CHEM Pipeline Enamels are Backed by a 4-Way Service Program

ON line after line, in all types of terrain and soil, tough, durable *Pitt Chem* Coal Tar Enamels have *proved* their superior ability to provide sure, economical pipeline protection—year after year. But there's *another* big reason why so many companies specify *Pitt Chem* Pipeline Enamels. And that's Pittsburgh's Four-Way service program:

1. Complete Quality Control As a basic producer, Pittsburgh maintains rigid quality control standards at every step of enamel production, from coal to finished coating.

2. Written Specifications Published to guarantee you consistently superior quality and performance from every drum of *Pitt Chem* Pipeline Enamels —in application and in service.

3. Experienced Sales Service *Pitt Chem* sales representatives are experienced coating men. They talk your language, will help you plan the many requirements of your coating job.

4. Technical Service Pittsburgh maintains a full time staff of field service men to work with your field men in the efficient, economical application of coattings. *Write us about your protection requirements!*

★ **PITT CHEM Pipeline Enamels**
★ **PITT CHEM Coal Tar Coatings**
★ **PITT CHEM Insul-Mastic Coatings**

PROTECTIVE COATINGS DIVISION
PITTSBURGH COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

WSW 6956

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Proposed or Planned Pipelines

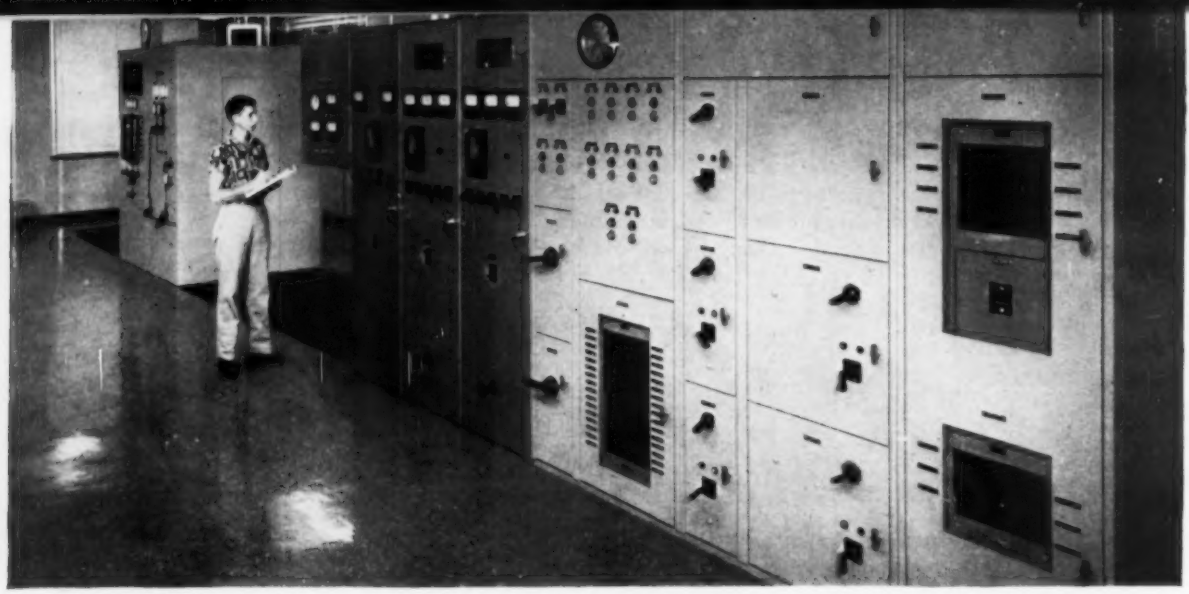
The following tables list the company, mileage, pipe size, and location of proposed pipeline projects — crude, products, and natural gas — reported to *The Pipeline Engineer*. Company addresses are given when known.

CRUDE LINES

Name of Company	Miles	Size	Location
Act Oils Toronto, Ontario, Canada	350		Line from Peace River area in British Columbia, thru Pine Pass to Prince George, westward to Bella Coola terminus on Pacific Coast
Afrique du Nord Development Societe	850	18	Hassi-Messaoud field, Algeria, to Mediterranean port
Alaska Yukon Pipe Lines, Inc.	254	—	Valdez to Tok Junction, Alaska
Alborz Oil Company	1000	38	Qum, Iran, to Alexandretta, Turkey
Argentine Government (YPF) Buenos Aires, Argentina	640	12	Campo Duran fields to Rosario
Atlantic-Cities-Service-Continental-Gulf-Phillips-Texas-Sinclair	Approx. 385	26	Midland, Texas, area to Houston
Bituminous Oil Pipeline, Ltd. Calgary, Alberta, Canada	250	—	McMurray to Edmonton, Canada
Bolivian Government (YPFB) La Paz, Bolivia	215	8, 10	Interior of Bolivia to Arica, Chile
Cape Pipe Line Company Philadelphia, Pennsylvania	200		Large diameter from Delaware Bay to Greater Philadelphia area refineries
Creole Petroleum Corp. Caracas, Venezuela	86	30	Tamblador field to Caripito, Venezuela
Great Northern Railway Co. St. Paul, Minnesota	800		Williston Basin to St. Paul-Duluth-Superior, Wisconsin-Minnesota area
Humble Pipe Line Co. Houston, Texas	90	16	Hawley to Comyn, Texas
Iraq Petroleum Co. London, England	Approx. 600		Kirkuk field to Iskenderun, Turkey
Jayhawk Pipe Line Corporation Wichita, Kansas	242	10, 12	Meade County, Kansas, to Valley Center
North-West Oil Pipelines Company	210		Wilhelmshaven, on the North Sea, to industrial Ruhr area of West Germany
Offshore Gathering Company Houston, Texas	364	20	Gulf of Mexico from Sabine Pass to Mississippi River
Oil Field Pipe Line, Inc. and Panhandle Eastern Pipe Line Co. Kansas City, Missouri	200	8, 12	Elkhart to Ellinwood, Kansas
Royal Dutch Shell Group and Others The Hague, Netherlands	870	30	Marseille, France, to Rotterdam, Holland, and Antwerp, Belgium
Royal Pipe Lines, Ltd. Regina, Saskatchewan, Canada	288	Var.	Cantuar area fields to Glenavon
Shell Pipe Line Corporation Houston, Texas	100		Southwest Pass Terminal to Norco, La., Refinery
Southern Kansas Pipe Line Company	310	6, 10	10,000 bbl per day line from Greenwood pool, near Colorado line, thru Liberal to Arkansas City, Kansas
Trans-Border Line Company	110		Skagway, Alaska, to Whitehorse, Yukon Territory
17 American, English, French and Dutch companies	1500	38–40	Middle East producing areas to Mediterranean Coast in Turkey
Yacimientos Petroliferos Fiscales Buenos Aires, Argentina	375-434		Challaco, Neuquen Province, to Arroyo Parejas

PRODUCT LINES

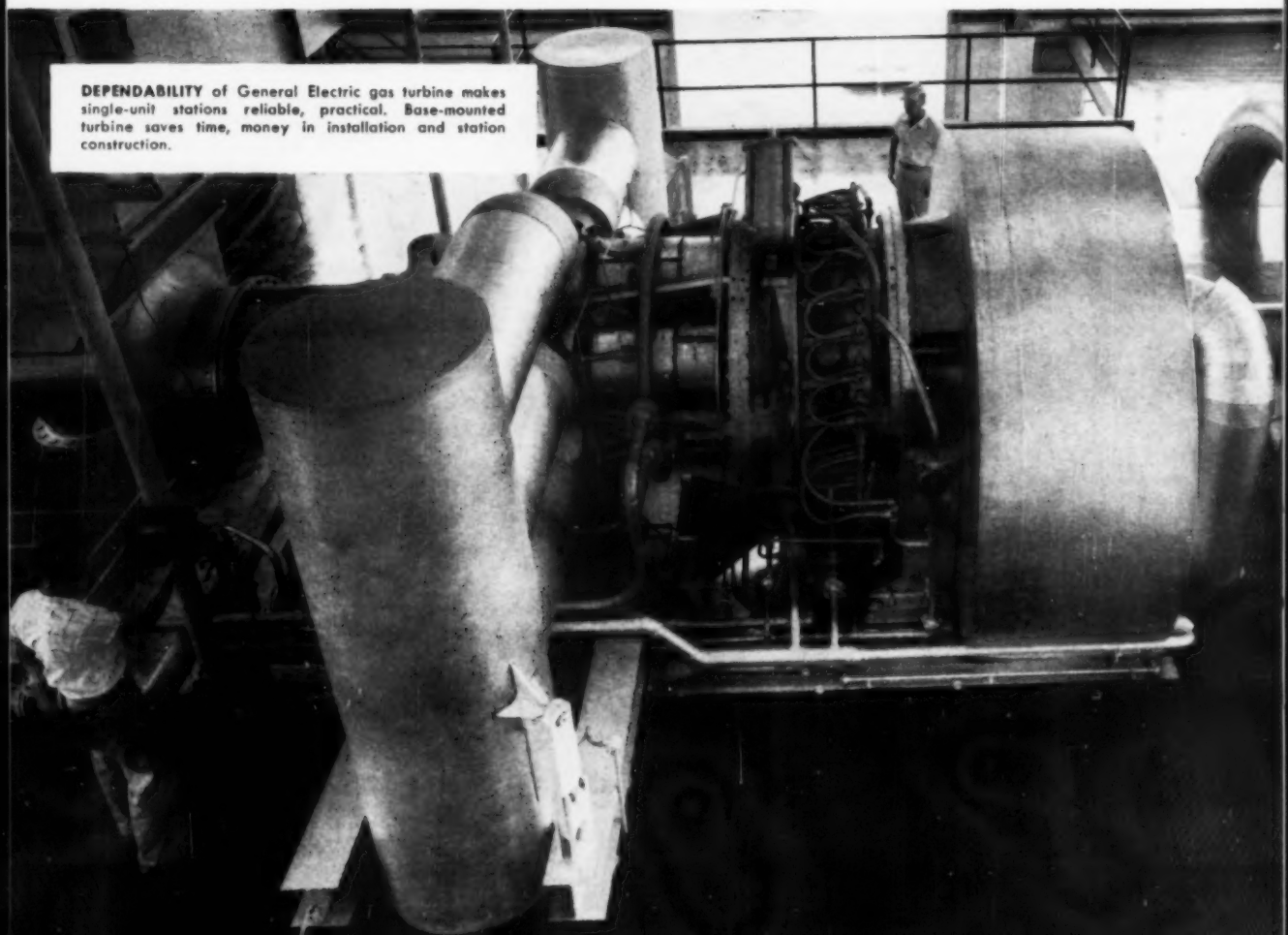
Name of Company	Miles	Size	Location
American Pipe Line Co. New York, New York	1910	8–26	Beaumont, Texas to Newark, New Jersey
Buckeye Pipe Line Company New York, New York	70	8	Wayne to Durand, Michigan, common carrier
Everglades Pipe Line Company Everglades, Florida	60	10	Pt. Everglades to Miami, Florida
Hydrocarbons Pipelines, Ltd. Winnipeg, Manitoba, Canada	800	6–8	Edmonton, Alberta, to Fort William, Ontario
Laurel Pipe Line Company Pittsburgh, Pennsylvania	350	14–24	Philadelphia to Pittsburgh to Cleveland
Mene Grande Oil Co. Caracas, Venezuela	60	6	Anaco to Puerto La Cruz, Venezuela
Northwest Pipeline Corporation Salt Lake City, Utah	350	8–10	Four Corners to Salt Lake City, Utah
Ohio Oil Company Findlay, Ohio	250	12	Hartford, Illinois to Griffith, Indiana
Service-Continental-Sinclair-Phillips	550		Salt Lake City, Utah to Spokane, Washington
Underground Storage and Exploration, Inc.	393	6, 8, 12	Moundsville, West Virginia, to Newark, New Jersey, with laterals to Mauch Chunk, Marcus Hook, and Philadelphia



CENTRALIZED CONTROL in convenient, easily accessible location affords one operator automatic operation of the drive system.

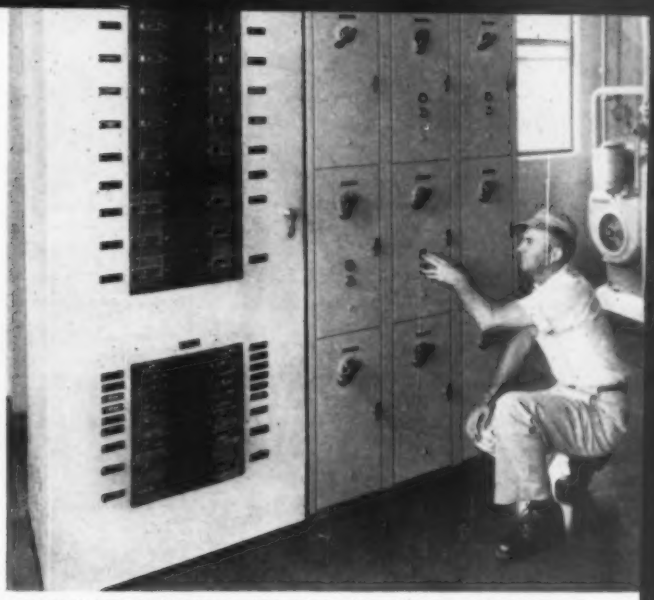
AT TENNESSEE GAS TRANSMISSION COMPANY . . .

New Compressor Station



DEPENDABILITY of General Electric gas turbine makes single-unit stations reliable, practical. Base-mounted turbine saves time, money in installation and station construction.

SAVINGS on installation, maintenance, and operating costs were the result of close co-operation between Tennessee Gas Transmission Company personnel and General Electric engineering services.



FACTORY ASSEMBLED General Electric Cabinetrol* panels afford centralized control of all station auxiliary equipment. Compact design requires minimum of station's valuable floor space.

Starts Up in Record Time

GENERAL ELECTRIC'S COMPLETE ENGINEERING SERVICES ORGANIZATION WORKING CLOSELY WITH TGT ENGINEERS FACILITATED INSTALLATION AND "START-UP" OF A G-E GAS TURBINE AT TGT'S SAVANNAH STATION IN RECORD 27 DAYS

Twenty-seven days after unloading its General Electric gas turbine, Tennessee Gas Transmission Company's new Savannah, Tenn. station was in operation. This record installation time was made possible through close co-operation between TGT engineers and General Electric's complete engineering services organization.

FROM DESIGN STAGES through application engineering, manufacture, installation, and operation, General Electric's wide experience in this field was utilized by TGT. The result was a drive system that exactly meets the particular station requirements of TGT.

DEPENDABILITY of all General Electric station and auxiliary equipment means a big dollar savings in terms of costly space, stand-by units, and emergency downtime.

TO HELP SOLVE YOUR STATION DRIVE REQUIREMENTS, General Electric makes available to you these complete engineering services. As with the Tennessee Gas Transmission Company installation, G-E engineers will co-operate closely with you in helping to design and install the drive system that exactly meets your station requirements. Get complete information from your nearest General Electric Apparatus Sales Office and meanwhile write for Bulletin GEA-6401, Combustion Gas Turbines, to General Electric Company, Section 661-56, Schenectady, N.Y. *Reg. trade-mark of General Electric.

Engineered Electrical Systems for Pipeline Pumping

GENERAL ELECTRIC

PRODUCT LINES

Name of Company	Miles	Size	Location
Union Oil Company of California Los Angeles, California	815		Shale oil plant, Rifle, Colorado to Los Angeles area
Winnipeg & Central Gas Company Winnipeg, Manitoba, Canada	210	6	U.S. Canadian border to Winnipeg

GAS LINES

Name of Company	Miles	Size	Location
Alberta Gas Trunkline Company, Ltd. Calgary, Alberta, Canada	449	6–34	Extensions to connect various fields
Andes Pipeline Corporation	500	12	Villamontes, Bolivia to Antofagasta, Chili
Argentine Government (YPF) Buenos Aires, Argentina	815		Campo Duran fields to Buenos Aires
Arkansas Louisiana Gas Company Shreveport, Louisiana	300		Main and gathering lines Louisiana-Texas Gulf Coast
Cities Service Gas Company Oklahoma City, Oklahoma	117	12–30	Replacements in Kansas
Coastal Transmission Corporation	574	22–26	McAllen, Texas to Baton Rouge, Louisiana
Dallas, Texas	414	Var.	Gathering lines in Rio Grande Valley, Texas
Colorado Interstate Gas Company Colorado Springs, Colorado	917	4–34	New lines, loops, replacements in Texas, Colorado, Nebraska, New Mexico, Kansas, Oklahoma
Cuban Gas Transmission Company (Edwin Pauley) Los Angeles, California	1000		Mexico to Florida via Cuba
Eastern Shore Natural Gas Company Salisbury, Maryland	124	6, 8	Transmission line and facilities in Delaware and Maryland
Edison Securities Company Los Angeles, California	130		San Joaquin Valley to Los Angeles
El Paso Natural Gas Company El Paso, Texas	599	6–30	New lines and loops, New Mexico and Arizona
Houston Texas Gas & Oil Company	942.6	12–30	Baton Rouge, Louisiana to Miami, Florida
Houston, Texas	682		Laterals to serve Florida distributors and industrial users
Michigan Wisconsin Pipe Line Company Detroit, Michigan	638	4–24	Laterals and loops in Wisconsin, Michigan, Missouri, Illinois, Indiana
Midwestern Gas Transmission Company Houston, Texas	2067	3–24	Main line from U.S. Canadian border near Emerson, Manitoba—Noyes Minnesota, to Portland, Tennessee Laterals off main line to serve communities in Minnesota, North Dakota and Wisconsin
Missouri Transportation Corp. Springfield, Missouri	280	16	Delaware County, Okla., to St. Louis, Mo.
Mookl Chemical & Gas Corp. Tulsa, Oklahoma	169	16	Pottawatomie County to Delaware County, Okla.
Natural Gas Pipeline Company of America	416	36	Loop from Beatrice, Nebraska to Joliet, Illinois
Chicago, Illinois	337	30	Loop from Fritch, Texas to Beatrice, Nebraska
Niagara Mohawk Power Corp. Syracuse, New York	196	2–16	Central, eastern, and northern New York
North Carolina Natural Gas Corp. Houston, Texas	625	2–16	Intrastate line in North Carolina
Northern Natural Gas Company Omaha, Nebraska	1355	2–30	New lines and loops, Minnesota, Wisconsin, Alberta, Texas, Oklahoma, Kansas, Nebraska, Iowa
Northern Plains Natural Gas Company (subsidiary of Northern Natural Gas Company) Omaha, Nebraska	1100	26	Alberta-Montana border to Minneapolis, Minnesota
Pacific Gas & Electric Company San Francisco, California	1300	36	Alberta, Canada, gas fields to Antioch, California
Petroleos Mexicanos Mexico City, Mexico	130	22	Reynosa to Monterrey
Piedmont Gas Co. Hickory, North Carolina	78	2-8	In Gaston, Lincoln, Catawba, Caldwell, and Burke counties, N. Carolina
Southern California Gas Co. **Southern Counties Gas Co.** Los Angeles, California	83	34	From Coles Levee to Newhall
Southern Natural Gas Company Birmingham, Alabama	371	4–20	Various lines in Louisiana and offshore
Tennessee Gas Transmission Company	556	30	South of New Orleans to Portland, Tennessee
Houston, Texas	76	24	Coudersport, Pennsylvania to Hamburg, New York
	163	30	Loop from Portland, Tennessee and Winchester, Kentucky to Lancaster and Morehead, Kentucky
	39	26	Loop from Catlettsburg, Kentucky to Broad Run, West Virginia
	12	26	Loop south of Mercer, Pennsylvania
	50	26	Loop from Morehead, Kentucky to Catlettsburg, Kentucky
Texas Eastern Penn-Jersey Corporation Shreveport, Louisiana	65	30	Loop from Delmont, Pennsylvania, to Lambertville, New Jersey
Trans-Canada Pipe Lines, Ltd.	492	30	New line from Kapuskasing, Ontario, to Sheridan, Ontario, Canada
Calgary, Alberta, Canada	48	24	New line from Winnipeg, Manitoba to Emerson, Manitoba, Canada
Transcontinental Gas Pipe Line Corporation Houston, Texas	375	3–36	Main line loops, laterals, extensions to system
Trans-Western Pipe Line Company Los Angeles, California	775		Four Corners area to point in California

GASOS ARE STANDARD WITH US

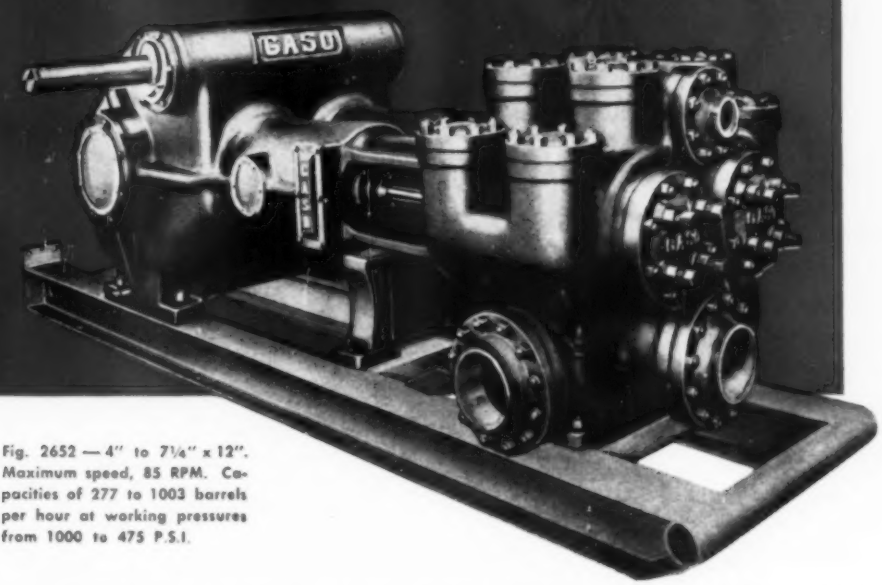


Fig. 2652 — 4" to 7¼" x 12". Maximum speed, 85 RPM. Capacities of 277 to 1003 barrels per hour at working pressures from 1000 to 475 P.S.I.

. . . BECAUSE THEY TAKE THE GUESSWORK OUT OF PUMP BUYING

As engineers, the men in my department deal in facts. They know from experience that Gaso offers models exactly suited to our various needs. They know from our service records that Gaso Pumps consistently deliver top service for unbelievably long periods, with remarkable low maintenance and upkeep costs. And they know from personal contact that they can rely on Gaso distributors for on-the-spot information, recommendations and parts service. Add up the advantages and you'll understand why we, as engineers, took the guesswork out of pump buying by making the specification of GASOS a company policy.

DISTRIBUTORS

W. L. SOMNER COMPANY, Shreveport, Louisana • Odessa, Texas • Tinsley, Mississippi • Brookhaven, Mississippi
POWER PUMPS, INC., Long Beach, California • Farmington, New Mexico
PEDDLERS, INC., Houston, Texas
PUMP ENGINEERING CO., Wichita Falls, Texas
LUFKIN FOUNDRY & MACHINE CO., Casper, Wyoming
HAGUE EQUIPMENT CO., INC., Evansville, Indiana
LUFKIN MACHINE CO. LTD., Edmonton, Alberta

GASO PUMP & BURNER MFG. CO.
TULSA, OKLAHOMA
Export Office: 149 BROADWAY, NEW YORK

GASO PUMPS
for every oil industry need

SPRINGFIELD GAS LIGHT CO.

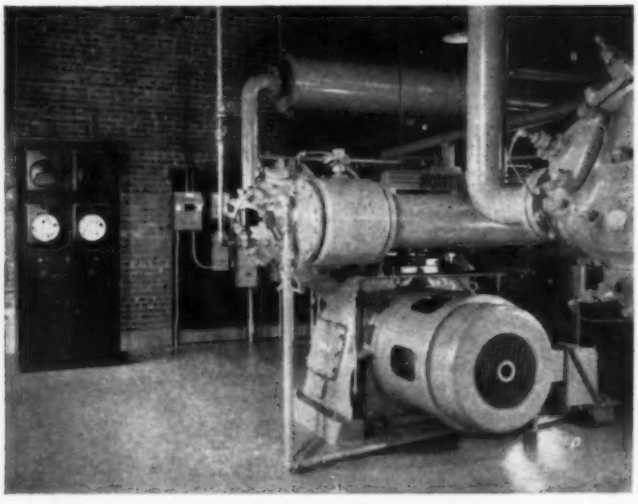
STABILIZES BY REMOTE CONTROL

...with Foxboro TELETAX* Telemetering

Here's another modern utility that's assuring highest efficiency in a key operation through Foxboro Teletax Telemetering. Using this advanced supervisory control system, the superintendent at Springfield Gas Light Company's main plant has complete command of gas stabilizing operations at the city gate, three miles away. A B.T.U. Recorder continuously shows him the heating value of the gas; a Teletax Receiver indicates the air/gas ratio being maintained. If gas varies from pre-set B.T.U. value, he pushes a button either to raise or lower air-to-gas ratio and restore proper B.T.U. value.

This is only one of many Teletax installations, specifically engineered to meet a wide variety of requirements. Assure *your* operation highest efficiency and economy with Teletax . . . for transmission of *any* standard Foxboro Measurement over *any* transmission system. Write for Bulletin 17-11A. **The Foxboro Company, 382 Norfolk St., Foxboro, Mass., U.S.A.**

Using Teletax Telemetering, the supervisor at Springfield Gas Light Co.'s main plant (above) controls desired, air/gas ratio at compressor station (below) three miles distant. The company purchases gas from the Tennessee Gas Transmission Company line, stabilizes it to maintain a constant B.T.U. value.



FOXBORO
Reg. U.S. Pat. Off.
TELETAX TELEMETERING

*Reg. U. S. Pat. Off.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

long-run power by Allis-Chalmers

If you specify "Allis-Chalmers motors or equal"

. . . remember that the "equal" is possible only in two respects: price and nameplate specifications. You can't match the *long-run power* of Allis-Chalmers motors.

Double-shielded bearings guarded against dirt and over-greasing . . . provision for elimination of moisture condensation . . . practically indestructible rotor design . . . more cooling surface . . . more iron and copper content — these are the features (with others) that make up long-run power. These are the features that give Allis-Chalmers motors "plus" performance that can't be equalled.

Find out more about the motors with long-run power from your A-C representative or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5663

These two Allis-Chalmers 6DA 779 engines pump crude oil from storage tanks into tankers for the American Liberty Marketing Co., New Orleans, at the Westwago terminal.

3 BIG reasons why you should use Allis-Chalmers Engines

They work day in, day out — season after season. Simplicity is a keynote of Allis-Chalmers design. There are a minimum of moving parts, and naturally, fewer parts mean less wear, less that can go wrong.

You enjoy 3-deep parts and service backing with practically "factory-town" service wherever you are! Allis-Chalmers' proven 3-deep dealer-branch-factory system means your dealer can obtain parts or factory-trained service help quickly from one of *18* strategically located factory branches.

There's an engine to EXACTLY fit your needs in the Allis-Chalmers complete line, 9 to 516 hp. Your choice of fuels, too — diesel, gasoline, natural or LP gas. See your Allis-Chalmers dealer, or write for complete information.

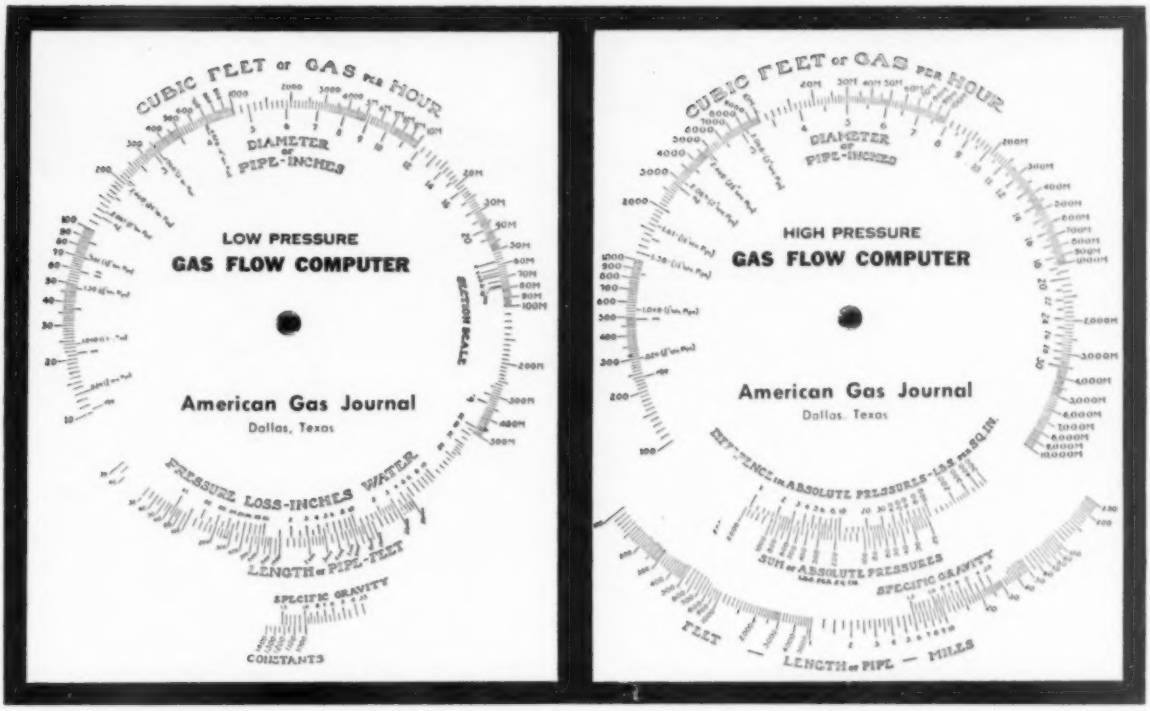
ALLIS-CHALMERS, BUDA DIVISION, MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS

BO-58

Speed up your calculations on pipe sizing, pressure drop, flow with the American Gas Journal . . .

GAS FLOW COMPUTERS



For LOW Pressures

Cubic feet of gas per hour	10 to 500M
Pipe diameters	¾-in. to 48-in.
Pressure loss (inches)	.01 to 50
Specific gravities	.35 to 1.5
Constants	1000 to 1400
Pipe length (feet)	30 to 30,000

For HIGH Pressures

Cubic feet of gas per hour	100 to 10,000M
Pipe diameters	¾-in. to 30-in.
Difference in absolute pressure to	500 psi
Sum of absolute pressures	20 to 2,000 psi
Specific gravities	.35 to 1.5
Pipe length (feet)	100 to 5,000
Pipe lengths (miles)	1 to 250

The computers are printed on heavy durable plastic, enclosed in Fabrikoid cases with complete instructions for their use.

PRICE: $7.50 EACH

PUBLISHED, COPYRIGHTED AND SOLD ONLY BY

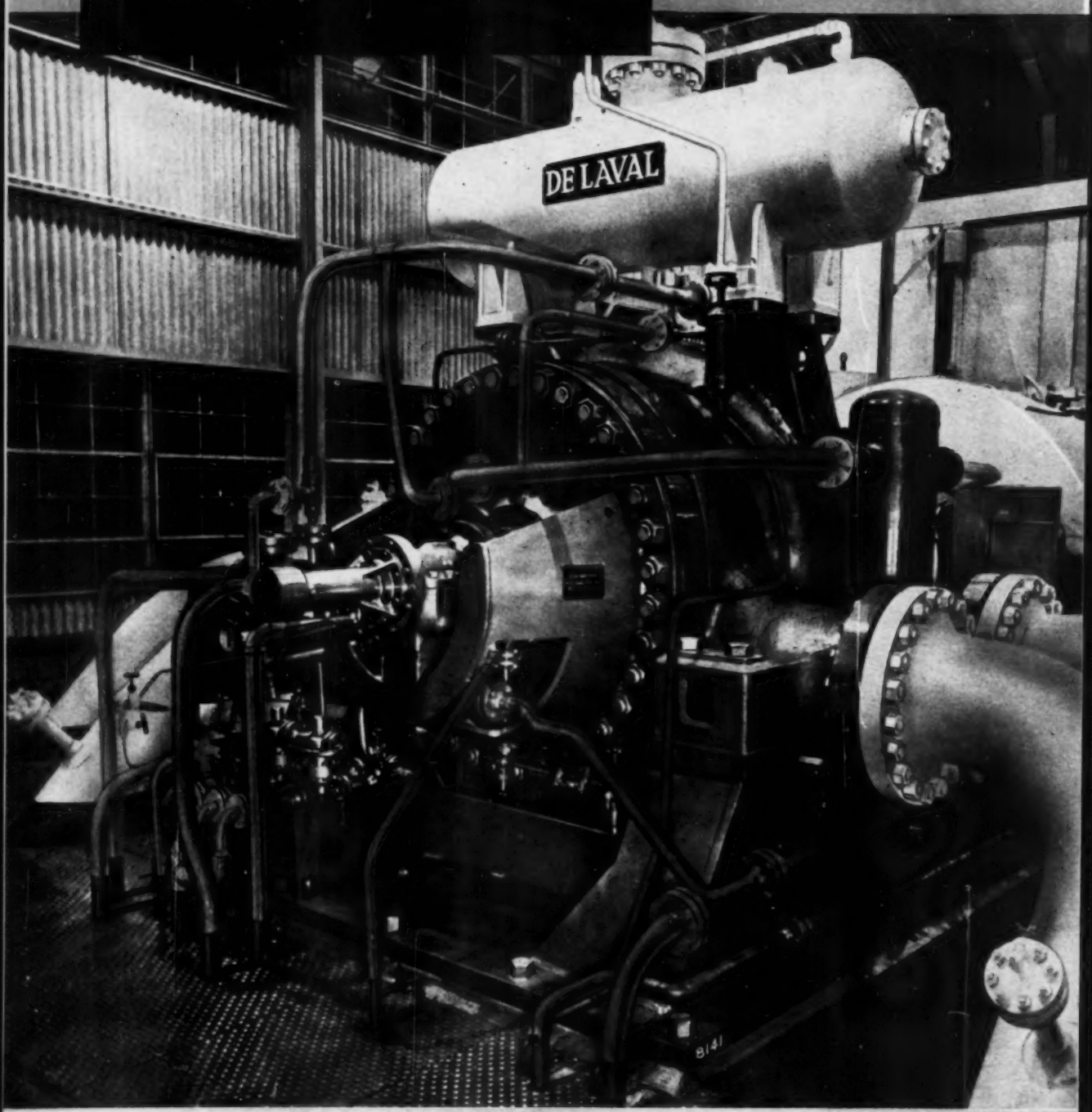
AMERICAN GAS JOURNAL

P. O. BOX 1589 • DALLAS 21, TEXAS

FOR FURTHER INFORMATION ON
ADVERTISED PRODUCTS, SEE READER SERVICE CARD

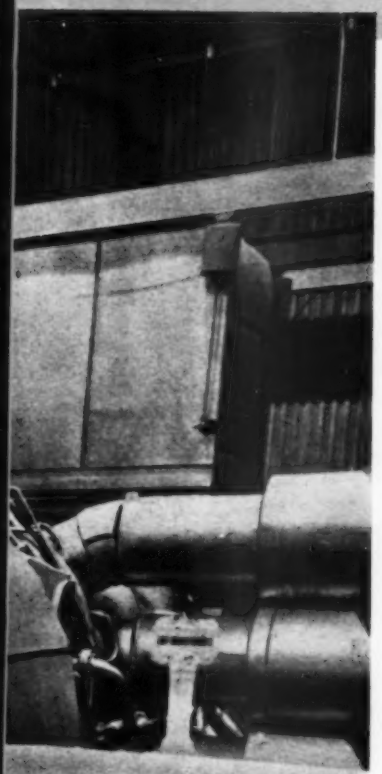
DE LAVAL
Series-Parallel
CENTRIFUGAL COMPRESSORS

provide extra



This De Laval Series-Parallel 6,350 hp centrifugal compressor is giving round-the-clock service in the Edna Station of the Trunkline Gas Company. Two other identical De Laval S-P units are doing a dependable job in the Kountze and Premont, Texas stations of this natural gas transmission system.

flexibility for Trunkline Gas Company

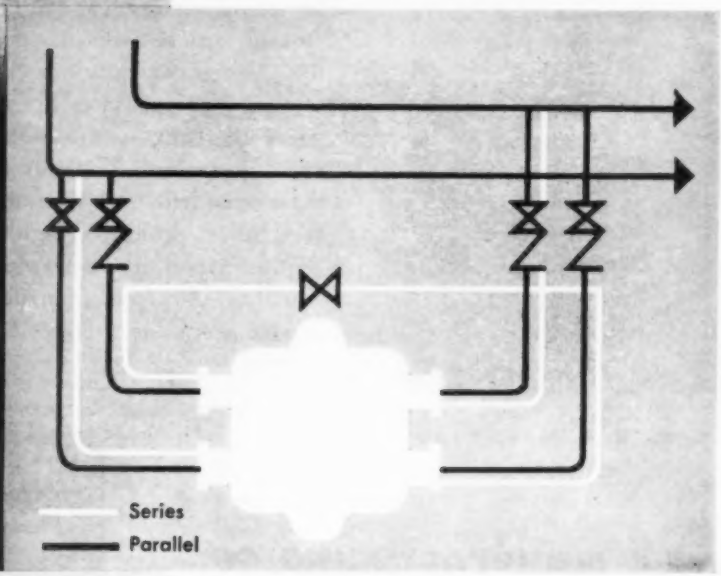


Booster station service demands flexibility in pipeline compressor design, which is available to a considerable degree in the standard De Laval single stage pipeline compressor. Some applications, however, require an exceptionally wide range, and the De Laval Series-Parallel centrifugal compressor has been designed to meet that need.

A good example is the De Laval Series-Parallel 6,350 hp compressor, shown in the photograph at left. It is one of three identical units serving booster stations of the Trunkline Gas Company.

S-P compressors are multi-stage units with the impellers arranged in two groups. Two inlet nozzles permit operating the impeller groups in series or in parallel as shown in the flow diagram. Within the horsepower limits of the driver, the compressor can be transformed from a high-flow, low-head machine to a low-flow, high-head unit *simply by operation of the external valving*. No changing of parts, not even a shutdown is necessary.

The reliability and economy of De Laval centrifugal compressors have been proved in natural gas transmission service throughout the country. You will find it pays to look to De Laval . . . the company that has specialized in the development of these units. De Laval pipeline compressors are operating in sizes from 2500–15,000 hp and with all types of drivers—gas turbines, gas engines, steam turbines and electric motors.

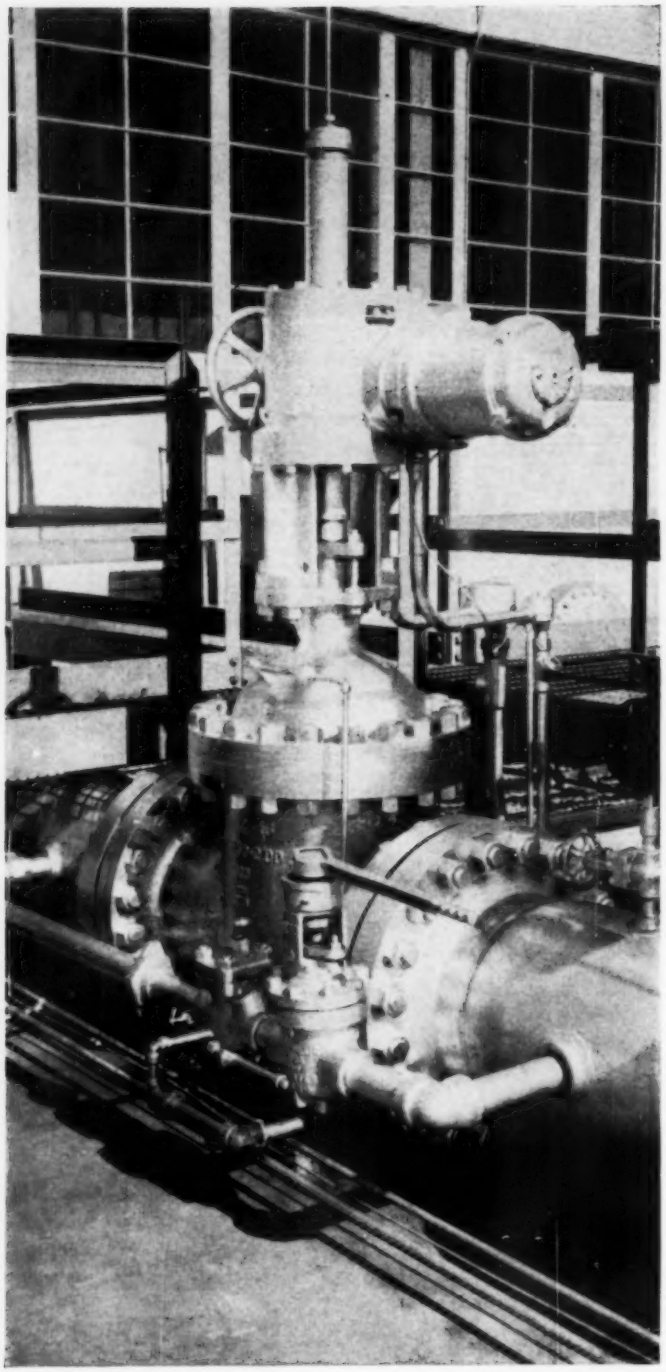


For additional information, write for the article "Tailoring Centrifugal Compressors for Pipe Lines" as well as De Laval Bulletin 503.

DE LAVAL *Centrifugal Compressors*

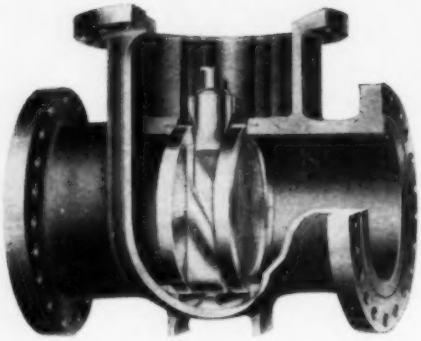
DE LAVAL STEAM TURBINE COMPANY
869 Nottingham Way, Trenton 2, New Jersey

the Kountze and Premont, Texas stations of this natural gas transmission system.



DARLING

fully-revolving double disc
pipe line gate valve



IDEAL FOR EFFICIENT CONTROL

Here's why

Operation is *consistently* trouble-free! Minimum friction, easy opening and closing, with self adjustment for positive closure. Wedging principle automatically compensates for any body deflection. Fully revolving discs avoid wear concentration. Discs and seats wipe clean with each operating cycle. In short . . . prolonged high efficiency with an extreme minimum of attention. It will pay you to give us an idea of your service needs and get specific details.

DARLING VALVE & MANUFACTURING CO.

Williamsport 2, Penna.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

869 Nottingham Way, Trenton 2, New Jersey

Applying NO-OX-ID Coating and Wrapper by Traveliner.

Mill- or yard-wrapping for long-term protection at its best.

Hand application of NO-OX-ID Cold Coating.

NO-OX-ID "C-M" Casing Filler protects casing and carrier pipe under highways and railroads.

NO-OX-ID coating-wrapper combinations are the versatile answer to every kind of pipeline protection

Whether you are installing distribution or transmission lines—whether you are working over rough or smooth terrain, there is a NO-OX-ID Coating and Wrapper Combination to give the right protection.

On mill-wrapped pipe, NO-OX-ID Coating, Wrapper and Service Coat protect from mill to ditch. NO-OX-ID can be applied over the ditch by Traveliner using less material and equipment. Hand-applied on short line installations, service lines or special fittings, NO-OX-ID goes on fast. No noxious fumes.

Leading pipeline contractors and utilities rely on versatile NO-OX-ID Coating and Wrapper Combinations. Consult with your Dearborn Pipeline Engineer. He will help you select the right combination for your next pipeline job.

New NO-OX-ID Catalog

This 12-page illustrated catalog tells how NO-OX-ID coating and wrapper combinations fit every job requirement. USE THE COUPON.

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PE-NO
Chicago 54, Ill.

☐ Send my copy of the new NO-OX-ID catalog.
☐ Have a Dearborn Pipeline Engineer bring my copy.

NAME.....TITLE.....

COMPANY.....

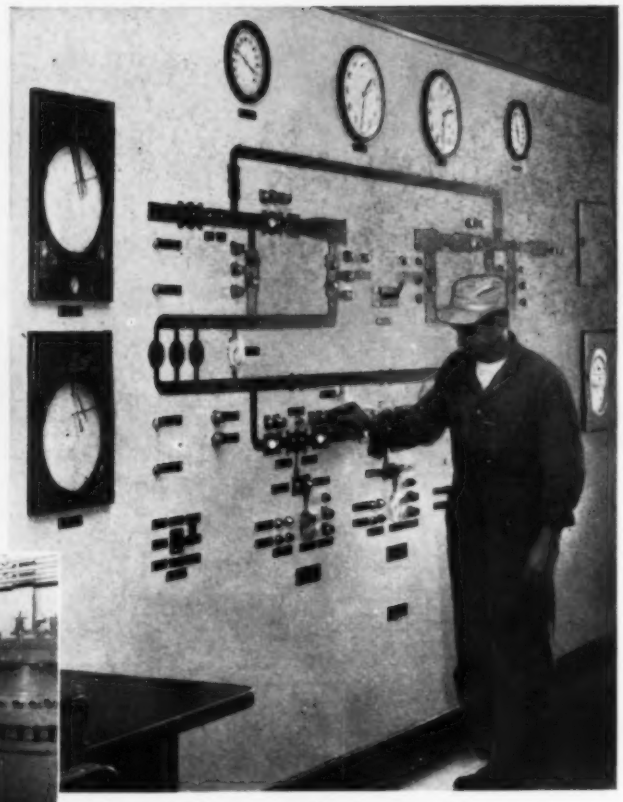
ADDRESS.....

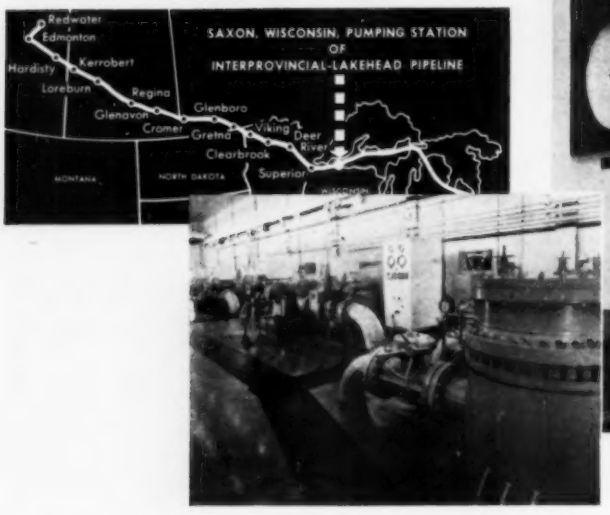
CITY.....ZONE....STATE.....

Dearborn® NO-OX-ID

Protecting Metal Against Corrosion Since 1887

Centrally located master panel indicates flow of crude through the Saxon station.





Three 10,200 gpm centrifugal pumps, their speed automatically regulated by Honeywell controls, keep heavy crude on the move.

Honeywell controlled pumping station helps boost capacity of world's longest crude oil pipeline

THE Interprovincial-Lakehead pipeline stretches 1,931 miles from the Alberta oil fields to Ontario refineries. The pumping station at Saxon, Wisconsin, is part of a long-term expansion program which has increased the capacity of the system to close to 300,000 barrels per day. The addition of the Saxon station increased the capacity of the line for deliveries to Michigan and Ontario by 34%.

The Honeywell automatic control system synchronizes the pumping rate of the new station with rates of other stations in the line. A master pneumatic controller monitors and regulates suction and discharge pressures. Tied into the controller are individual controls for each of the station's diesel engines. These controls automatically speed up or slow down operation of each engine to regulate the flow of crude. Built into the control system are a variety of protective instruments which can instantaneously shut down the station when required, or signal abnormalities in pressures or engine operation. Supervision is centralized in a 15-foot master control panel.

The accuracy and dependability that make Honeywell instrumentation a paying proposition here can be applied to your application. Your nearby Honeywell field engineer can tell you how. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

H HONEYWELL *First in Controls*

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Students between classes at University of the Andes.

University of The Andes Correlates Studies With U. S. Institutions

Colombian students from Andes University are accepted in several U. S. universities without examinations . . . U. S. Advisory Board aids work . . . Has engineering scholarships

OF THE 10 universities in Colombia that teach some type of engineering, the most unusual appears to be the University of the Andes (Universidad de Los Andes). This school, founded in 1949, planned its studies to correlate as closely as possible with that of North American universities. The university made arrangements with colleges in the United States to accept transfer students in their junior year, permitting them to complete their studies in schools specializing in engineering.

The first U. S. university to agree to admit students from the University of the Andes into junior-year status and without entrance examination was the University of Illinois. The decision was made after careful study of the academic studies of the University of the Andes and it served as a basis for similar agreement with the Universities of Pittsburgh and Texas.

Although Bogota, capital of Colombia, already had four existing universities, the University of the Andes has been successful since the Colombian Ministry of Education granted its charter. The university began its program with the total enrollment of 78 students. Last year it had 625 students in its school of engineering, architecture, economics, and liberal arts. Largest school is that of engineering, which in 1956 had 337 enrolled.

The faculty includes scholars from the United States, Latin America, almost every country in Europe, and several from Asia, besides Colombians, who make up almost half of the total of 87 staff members. Dean of the engineering school is Dr. Alvaro Salgado.

A Colombian student of mathematics at Columbia University in New York, Mario Laserna, first proposed the University of the Andes and he inspired those around him with the idea.

One sound reason for the new approach was that South Americans of the money class went north to U. S. universities to acquire knowledge in scientific and technical fields not available at home. Because there was a complete lack of coordination of study programs, the student lost valuable time trying to adapt his academic standing to that of the north, and his studies abroad became so expensive that only the wealthiest could afford to complete them.

So the Andes University became a

catalyst between North and South American education. In this role of international coordination the university has only begun to make headway. Occasional exchange programs have been carried out with a few United States schools and they are likely to expand from year to year. Primary aim of the University of the Andes is to serve as a bridge for Colombian students to the United States.

Home industries are vitally interested in having U. S.-trained Colombians work for them in jobs for which they have formerly hired foreign experts at greater cost. Industrial expansion in Colombia is still in its infancy and the demand for technically trained personnel far exceeds the supply. The University of the Andes has become an important factor in providing the technicians.

The school is closely linked with the university system in the United States in three ways:

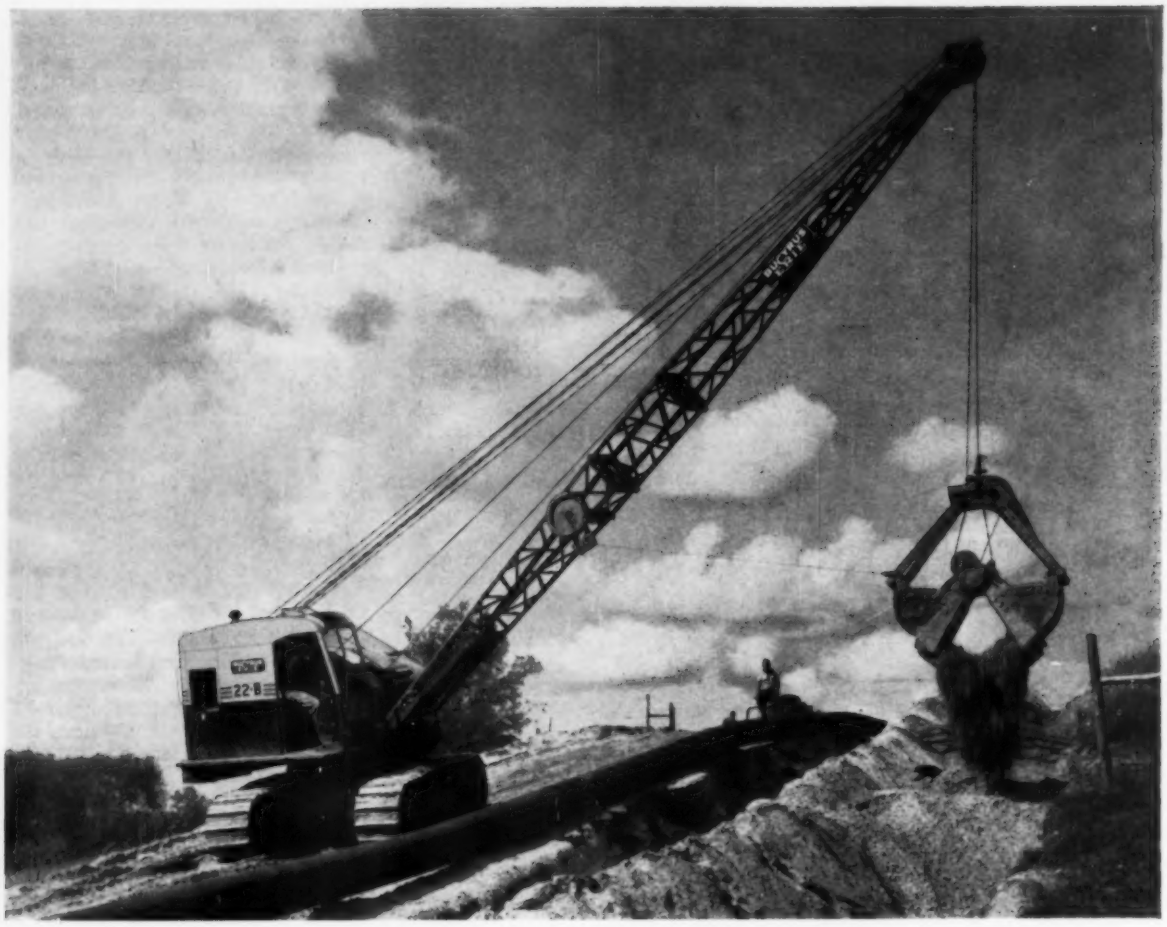
1. Basic ideals of orientation and organization are the same as those of large U. S. universities. The academic set-up requires frequent homework, research assignments, and careful supervision by the professor, so that the student is in constant touch with his teacher and can broaden his field of knowledge as well as his ability to acquire it. This system of controlled study of verified results, and of constant vigilance of the Academic Dean is what has most distinguished the University of the Andes.

2. The second bond is its Advisory Board, made up of men prominent in university and scientific activities who are currently residing in North American academic centers. The members of this Board have always been in agreement with the aims of the university and have offered it generous cooperation.

These men include such figures as the mathematician, John von Neumann, of the Institute of Advanced Study of Princeton and of the Atomic Energy Commission; David G. Monroe, director of the Woodrow Wilson School of International Affairs at Princeton; Dietrich von Hildebrand, Jacques Maritain and Ernst Nagel, outstanding names in contemporary philosophy.

The board helps draft the program of studies, recommends and suggests candidates for the various chairs, and gives short courses at the University in Bogota.

3. The university's third tie with North American universities is its scholarship program for engineering students. On satisfactory completion of their fifth semester at the University of the Andes, they are accepted as junior students at the Universities of Illinois, Pittsburgh, and Texas. ★ ★ ★



Bucyrus-Erie 22-B Clamshell Speeds Pipeline Ditch Cleanout

When the Michigan-Wisconsin Pipeline Co. began construction on a natural gas line from Oshkosh to Waukesha, Wis., this Bucyrus-Erie 22-B clamshell was chosen for ditch cleanout work. Shown here just south of West Bend, Wis., it was one of five 22-Bs on the spread. These machines helped keep things moving at a steady clip through terrain consisting of sand, clay, muck and rock.

The 22-B is built to work efficiently under adverse conditions. Optional tractor-type crawler mounting provides extra clearance for safe travel over rocks, stumps and most other obstructions normally encountered. Tractor-type treads have deep grousers for sure traction in soft ground and for climbing steep grades. Special sealing helps protect track-roller bearings against damage from water, dust, dirt, and grime.

Bucyrus-Eries offer the type of performance *and dependability* that keep jobs moving on schedule regardless of obstacles.

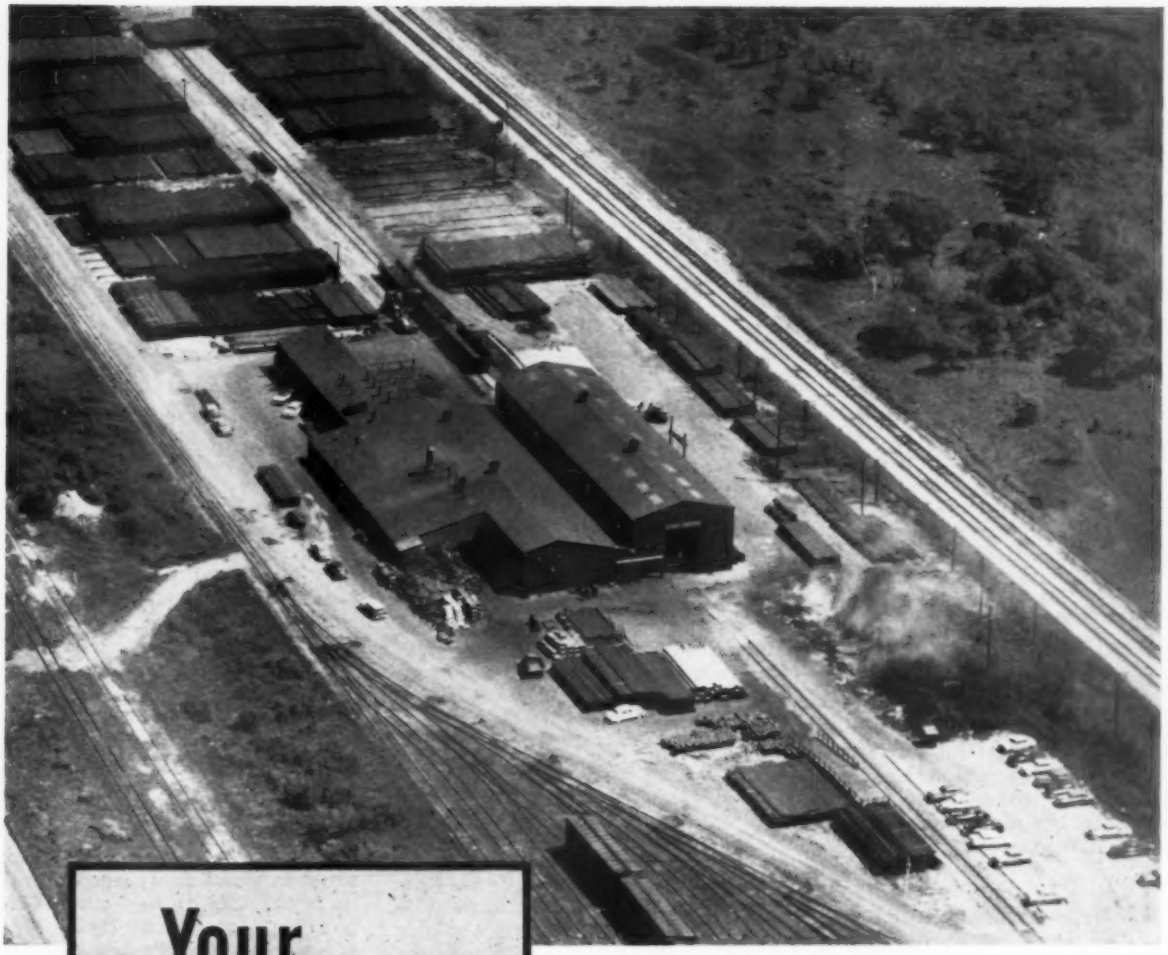
For more information on the rugged, high-output features of Bucyrus-Erie cranes and excavators, see your Bucyrus-Erie distributor today.

385E57

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



Aerial view of Hammond, Indiana plant, newest of the chain of Hill-Hubbell plants that serve the nation.

Your confidence built this new plant!

Consistent quality and proved responsibility have made Hill-Hubbell the most respected name in the pipe-wrapping field.

Through the years, Hill-Hubbell has pioneered many advances in the pipe-wrapping industry... advances that have resulted in new and improved industry-wide methods of pipe protection.

For example, Hill-Hubbell was first with permanent plants equipped with stationary precision-control coating and wrapping machines; first with fully-enclosed pipe-wrapping plant buildings; first with the "Unit-load" system; first with Roto-Grit blast cleaning; first with electronic pipe inspection; first with identifying code number stamping on pipe.

Hill-Hubbell engineers continue to work for your benefit, developing better means of coating and wrapping pipe.

Specify Hill, Hubbell wrapped pipe on your next job

HILL·HUBBELL & COMPANY

DIVISION OF GENERAL PAINT CORP. • 3091 MAYFIELD ROAD, CLEVELAND 18, OHIO

Crude oil capacity now stands at 227,100 bbl a day, refined products at 120,700 bbl, and new projects are planned

Area of Promise

Colombia's Pipeline Network EXPANDING

Waldemar Bellon
Bogotá, Colombia

THIRTY-FIVE YEARS AGO, on October 1, 1923, the Colombian Government signed a contract with Andian National Corporation, Ltd., a subsidiary of International Petroleum Company for the construction of the first pipeline in Colombia. This pipeline was completed on March 6, 1926, and the first crude oil pumped through the 355-mile system on June 10, 1926.

The line runs between oil fields of the Mares Concession, held then by Tropical Oil Company, to Mamonal on the Caribbean Sea some 15 miles south of Cartagena. Its original cost was Ps. 23,627,000 (U. S. $9,450,800).

It is still in operation but has been expanded and beginning in 1950 has had a capacity of 78,000 bbl per day.

Crude oil is pumped from the Mares Concession, now held by the government-owned Empresa Colombiana de Petroleos (Ecopetrol), and from Shell and Texas fields on the Middle Magdalena River from where short pipelines connect with the trunk system at Galán, Puerto Wilches, and Plato.

Pipelines for refined products had their inception in 1947, and were intensified in later years due to the mountainous character of the country that makes highway and railroad transportation slow and difficult. Even transportation on the Magdalena River by tanker is often made difficult because of low water during the dry season, so that a network of pipelines became necessary from the oil refinery at Barrancabermeja (Galán) on the Middle Magdalena River to the principal distribution centers.

Andian National Corporation

Andian National Corporation, longest and oldest pipeline, extending from El Centro (Mares Concession) to Mamonal, has 18 pumping stations over its 355-mile length, and operates in two parallel lines of 10 and 12-in. Maximum operating pressure is 700 psi.

This pipeline is fed by the following branches:

Pipeline Velásquez Galán, belonging to Texas Petroleum Company, has a total length of 45 miles and a diameter of 12-in. It has a capacity of 30,000 bbl per day and operates at a maximum pressure of 750 psi. It was completed in 1955 at a cost of Ps. 15.0 million (U.S. $6.0 million). With only one pumping station it carries the crude oil from the Texas Petroleum fields in the Puerto Niño area to Galán from where the Andian pipeline takes over.

There are several other short branches that connect with the Andian pipeline. Three lines belonging to Shell de Colombia have the following characteristics:

Casabe-Galán, 6.5 miles, diameter 10.5-in., one pumping station, a maximum pressure of 200 psi and a daily capacity of 60,000 bbl. It was completed in 1945.

Cantagallo-Puerto Wilches with a total length of 1.6 miles, a diameter of 4-in., one pumping station, and a maximum pressure of 800 psi. It has a daily capacity of 1000 bbl and was completed in 1947 at a cost of Ps. 108,000 (U.S. $55,200).

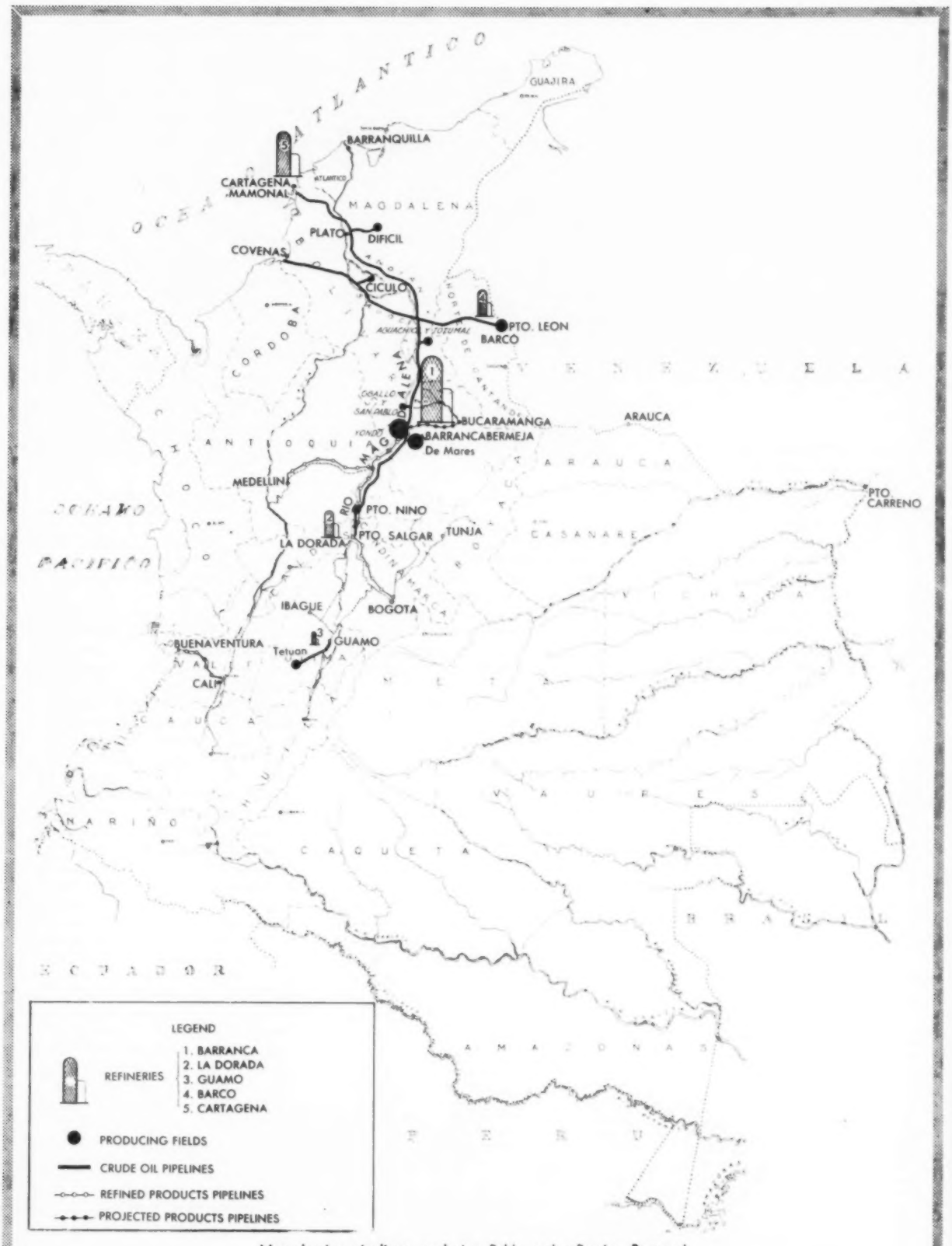
El Difícil, Plato with a total length of 53.5 miles, a diameter of 6 and 10-in., one pumping station, and a pressure of 500 psi. Its daily capacity is 13,200 bbl. It was completed in 1948 at a cost of Ps. 2,583,000 (U.S. $1,300,000).

International Petroleum (Colombia) Ltd., the Colombian affiliate of International Petroleum Company, owns two short branch lines connecting with the trunk line of Andian National Corporation in Puerto Mosquito. One comes from Intercol's field at Aguachica and has a length of 11 miles, a diameter of 4-in., and one pumping station. Capacity is 5000 bbl per day. The line was completed in 1955 at a cost of Ps. 378,000 (U.S. $146,000). The other line comes from Intercol's Totumal field and has a length of 12 miles, is 4-in. in diam and has one pumping station. It carries 5500 bbl per day and was completed in 1955 at a cost of Ps. 244,000 (U.S. $97,000).

South American Gulf Oil Company

Sagoc, a subsidiary of Colombian Petroleum Company, which owns the

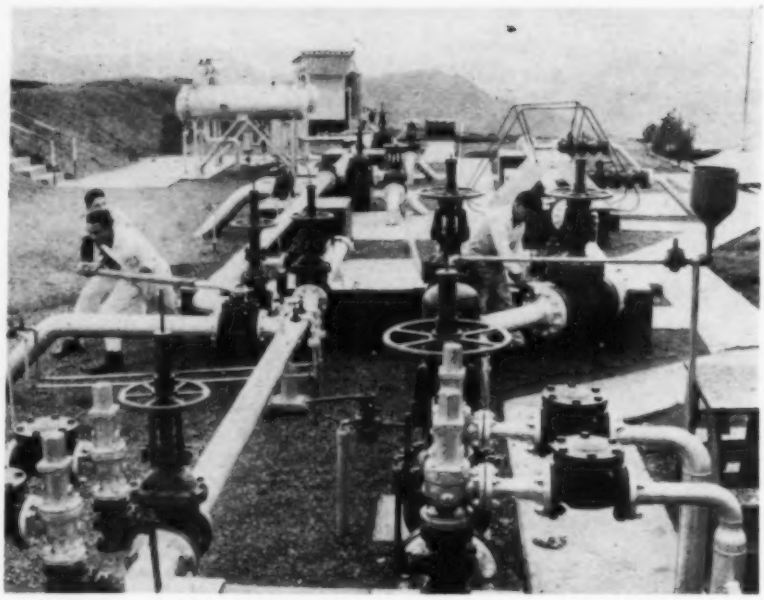
General view of installations at Puerto Salgar, Oleoducto de Cundinamarca.



Map showing pipelines, producing fields, and refineries. Prepared by Ministerio de Minas y Petroleos, Division Nacional de Petroleos.

Barco Concession in the Cúcuta area, built the second largest pipeline in Colombia in 1939, which has a total length of 263 miles and a daily capacity of 27,000 bbl. It operates with three pumping stations at a pressure of 900 psi. Diameter is 12-in. The line extends from Petrolea, north of Cúcuta, to Coveñas, 70 miles south from Cartagena on the Caribbean Coast, crossing the Andian pipeline near La Gloria on the Lower Magdalena River.

In 1957, Colombian Petroleum Company built a short line from its newly discovered field at Cicuco near Magangué on the Lower Magdalena. Should the Cicuco field develop into a major producer, Colombian Petroleum officials believe it may become necessary to build an additional pipeline to Coveñas because Sagoc's present line is already operating at full capacity.



Pumping station at Albán.

Texas Petroleum Company

Besides the crude oil line already described under the Andian National Corporation system, Texas Petroleum Company operates two other small lines. One leads from Puerto Niño to La Dorada where Esso Colombiana operates a small topping plant. This pipeline has a length of 46.5 miles and a daily capacity of 4000 bbl. It operates with two lines of 4 and 6-in., respectively, one pumping station, and a maximum pressure of 1200 psi. Completed in 1952, it cost Ps. 2,833,000 (U.S. $1,130,000).

Texas Petroleum Company also has a small field at Tetuán in the Tolima Department from where a 21-mile pipeline leads to a small refinery at Guamo. This line operates with a maximum pressure of 600 psi and is 4-in. in diam. It has a capacity of 3400 bbl per day and was completed in 1953 at a cost of Ps. 589,000 (U.S. $240,000).

Empresa Colombiana de Petroleos

Empresa Colombiana de Petroleos (Ecopetrol) was founded in 1951 when the Mares Concession of Tropical Oil Company reverted peacefully to the Colombian Government. It is a wholly government-owned company which exploits the old Mares Concession and has several new explorations farmed out to U.S. companies. It also owns the 35,000-bbl-a-day refinery at Barrancabermeja. Through three connected pipelines Ecopetrol carries refined products of the refinery along the Magdalena Valley southward from Barrancabermeja.

The pipeline Galán-Cantimplora, which is 60.5 miles long, has a daily capacity of 24,000 bbl and operates with one pumping station at a pressure of 1200 psi. Diameter is 8-in. It was completed in 1954 at a cost of Ps. 4.0 million (U.S. $1.6 million).

A second pipeline from Cantimplora to Puerto Salgar already had been built in 1953 to overcome the transportation difficulties by tanker on the Magdalena River. This pipeline is 92.6 miles long, has a daily capacity of 19,000 bbl, a diameter of 8-in., operates with a maximum pressure of 1200 psi. There is one pumping station. Its original cost was Ps. 9,345,000 (U.S. $3.9 million).

A short line crossing the Magdalena River from Cantimplora to Puerto Berrío had already been built in 1947. It is only 3.5 miles long, and operates at a maximum pressure of 150 psi with one pumping station. Through two lines of 2 and 6-in. it carries a maximum load of 15,400 bbl a day. The original cost including construction of the pumping station was Ps. 2,000,000 (U.S. $1.0 million).

Departamento de Cundinamarca

To solve the serious supply problem of Bogotá and the plateau to the north, the Cundinamarca Department built a pipeline for refined products that was completed in 1952, but later expanded to allow the pumping of LPG. This modification was completed in 1957. The high cost of this 90-mile pipeline, known as Oleoducto de Cundinamarco, Ps. 9.5 million (U.S. $3.8 million), is explained by the fact that the three pumping stations have to overcome a maximum altitude of 9140 ft.

The initial station at Puerto Salgar on Magdalena River is at an altitude of 580 ft. The highest point is entering Sabana de Bogotá at La Tribuna, 9140 ft. Terminal Bogotá is at 8510 ft.

Three pumping stations each has two variable stock pumps for 120 gal per min and one fixed stock pump of 130 gal per min operating in parallel. They are powered by 180-hp engines.

Stations discharge at a pressure of 1300 psi, which declines to 25 to 100 psi by time of arrival at the next station.

TABLE 1. Crude Oil Systems in Colombia.

Owner	From	To	Size, in.	Length, miles	Capacity, bbl/day
Andian	El Centro	Mamonal	10, 12	355	78,000
Sagoc	Petrolea	Coveñas	12	263	27,000
Texas	Anisales	Guamo	4	21.0	3,400
Shell	El Difícil	Plato	6, 10	53.5	13,200
Texas	Puerto Niño	La Dorada	4, 6	46.5	4,000
Shell	Cantagallo	Puerto Wilches	1.6		1,000
Shell	Casabe	Galán	10.5	6.5	60,000
Texas	Velásquez	Galán	12	115	30,000
Intercol	Aguachica	Puerto Mosquito	4	11	5,000
Intercol	Totumal	Puerto Mosquito	4	12	5,500
Sagoc	Cicuco			10	

Altitude of stations:

Puerto Salgar, 580 ft above sea level.

Dindal, 1350 ft, installed in 1957.

Guaduas, 4070 ft.

Albán, 6330 ft.

When only motor fuel is being pumped capacity of the line is 13,000 bbl a day. When several products are being moved through the line capacity declines to 10,000 bbl.

An expansion program is underway that will make possible pumping of LPG early in 1958.

A study is being made also that would bring total capacity to 35,000 bbl a day. This would require the laying of a completely new 10-in. line to supplement the present 6-in., but would make for more economical operation.

Ferrocarril de Antioquia

Antioquia Pipeline, built for the Ferrocarril de Antioquia, extends from Cantimplora to Medellín, 113 miles. There are three pumping stations, operating at a pressure of 750 psi. Diameter of the line is 6-in. Its daily capacity is 8300 bbl. When completed in 1955 it cost Ps. 12,000,000 (U.S. $8 million).

Oleoducto del Pacífico

International Petroleum Company, Esso Colombiana, the Valle del Cauca Department, and private investors formed Oleoducto del Pacífico S.A., which built a pipeline from the Pacific port of Buenaventura to Yumbo, the industrial suburb of Cali. This 61.5-mile line with diameters of 6 and 8-in. operates at a maximum pressure of 1500 psi with two stations. Its maximum capacity is 44,000 bbl a day. It was completed in 1956 at a cost of Ps. 13.5 million (U.S. $5.4 million).

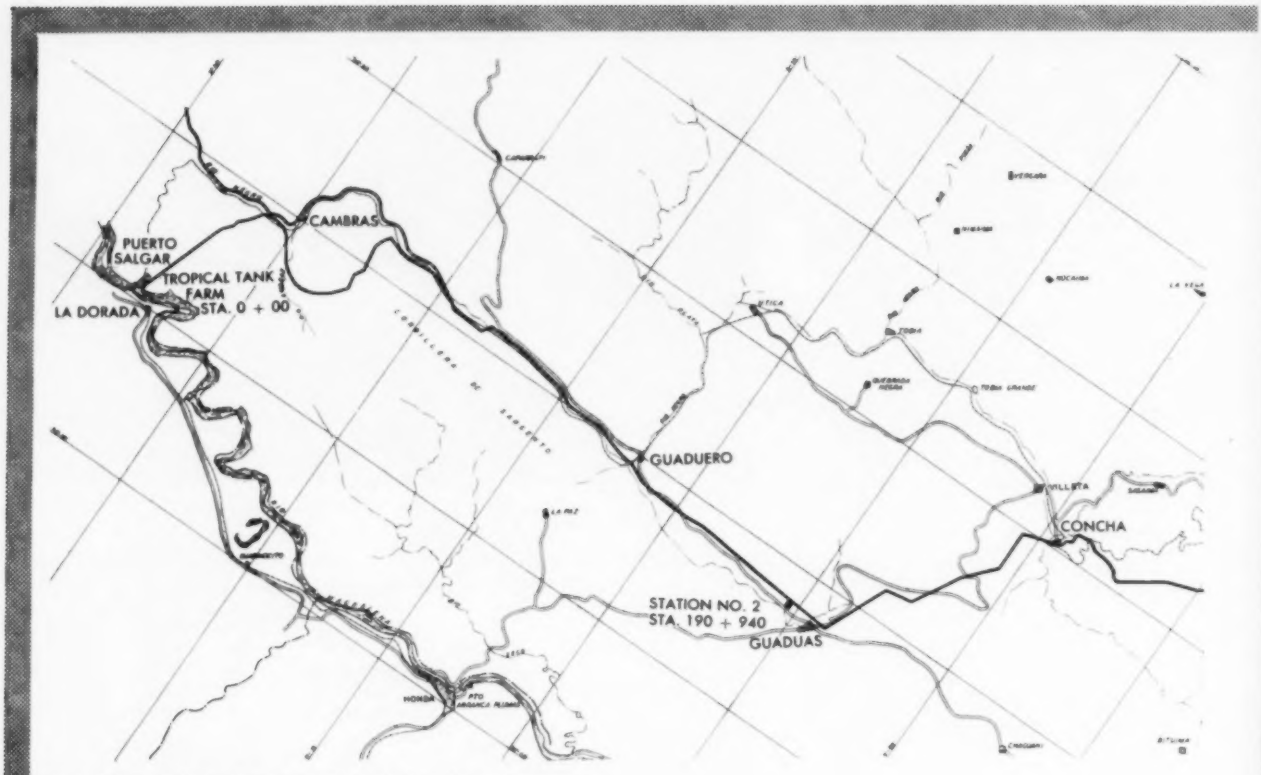
There exists a project for the construction of a new pipeline from Galán to Barrancabermeja, which will be about 75 miles long and will cost $3,000,000. Preliminary studies have been made by Williams Brothers Company, who have built most of the pipelines in Colombia. Difficulties of financing this pipeline for refined products have so far held up the final decision, but the consumption of the Bucaramanga area may soon warrant construction of this line.

There has been some talk about the construction of another line for refined products from La Dorada to Manizales, but the high cost of such a line, which has to cross the Central Cordillera and overcome altitudes of more than 10,000 ft, together with relatively small demand in the Manizales area, does not seem to justify this construction at present. ★ ★ ★

Terminal at Bogotá with tankage facilities.

TABLE 2. Refined Products Systems in Colombia.

Owner	From	To	Size, in.	Length, miles	Capacity, bbl/day
Ecopetrol	Galán	Cantimplora	8	60.5	24,000
Ecopetrol	Cantimplora	Puerto Berrio	2, 6	3.5	15,400
Ecopetrol	Cantimplora	Puerto Salgar	8	92.6	19,000
Departamento de Cundinamarca	Puerto Salgar	Bogotá	6	90	10,000
Ferrocarril de Antioquia	Cantimplora	Medellín	6	113	8,300
Oleoducto del Pacífico	Buenaventura	Yumbo	6, 8	61.5	44,000



Route of Puerto Salgar-Bogota products pipeline shown by heavy line.

LAYING PIPELINES in COLOMBIA

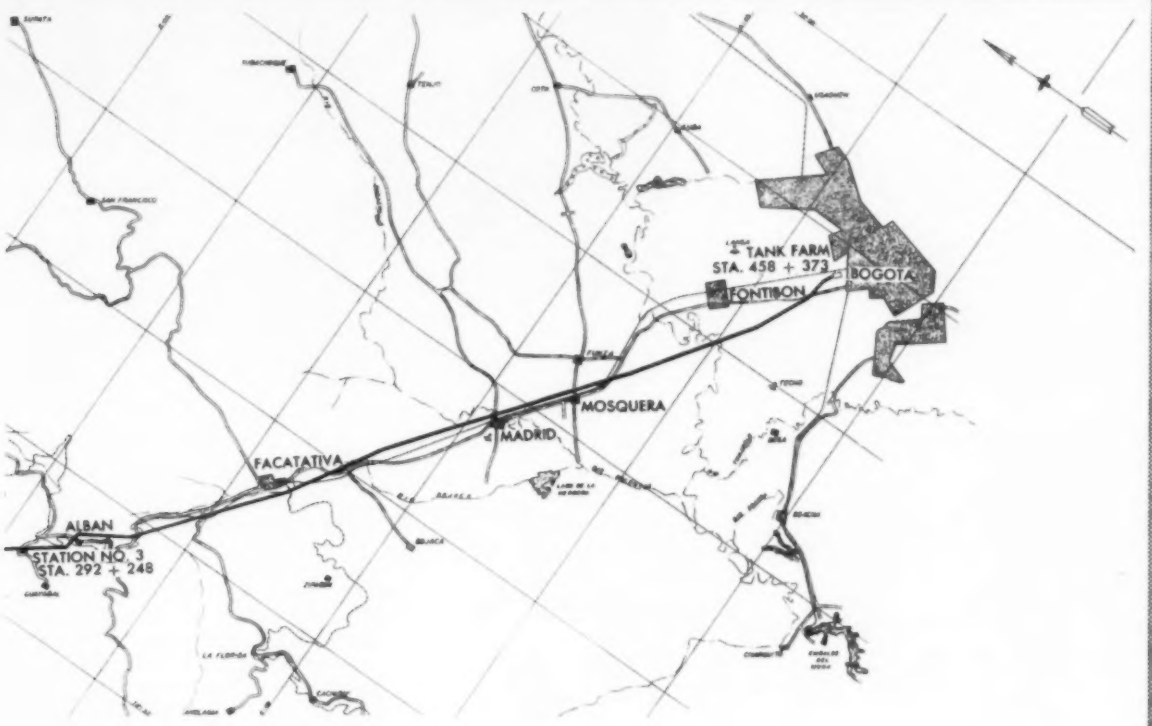
Rail and road access is limited, rain prevents work much of year, mountain ranges rise to 19,000 ft, swamps and jungles cover the lowlands

Wilson N. Gilliat,
Chief Engineer
Williams Brothers Company

Williams Brothers Company has been continuously active in Colombia, South America, for many years, engineering and constructing pipeline systems including pump stations and terminals, and recently building roads. In fact, most of the pipelines laid in Colombia in recent years have been by this company, and a permanent office is maintained in Bogota to coordinate such work. — Editor's Note.

UNIQUE TYPES OF TERRAIN and climate have been encountered in the engineering and construction of pipeline systems in Colombia. Rail and road access is limited in most areas. Rainy seasons prevent work during much of the year. Rugged mountain ranges, rising to 19,000 ft, divide the eastern and western sections of the country. Extensive swamps and dense jungles cover the lowlands. Most areas are remote from sources of supplies, necessitating long term and imported food stocks in construction camps.

A products pipeline system was recently completed between Buenaven-



is a RUGGED BUSINESS

P 615.

tura and Cali. The line is 107 kilometers (67 miles) long and telescoped from 8 to 6-in. diam pipe. Buenaventura is a seaport, with an annual rainfall of more than 300 in. The pump station there was erected on piles, and the construction area was a sea of mire continuously.

This pipeline traverses the jungle area surrounding Buenaventura and extends up through steep mountain slopes to reach the city of Cali. Much of the route was along a mule trail some six feet wide carved through a mountain range by the Spanish Conquistadors. Pipe along the trail was strung by mules, since the narrow ledge precluded vehicle operations. A special portable bending machine was devised to effect pipe bends along the precipitous route.

A 6-in. products pipeline was redesigned, rebuilt, and operated for several years by Williams Brothers, traversing 197 kilometers (123 miles) from Puerto Berrio on the Magdalena River to Medellin. An unusual construction problem was encountered here since Medellin is completely inaccessible by road from Puerto Berrio.

Two pipeline systems have been built that are entirely in the swampy and jungle terrain of the Middle Magdalena River Valley. One is an 8-in. products system from Cantimplora to Puerto Salgar, 140 kilometers (87 miles) long. The system was constructed on a turnkey basis and operated for the customers. The other is a 4 and 6-in. crude line 62 kilometers (39 miles) long from Puerto Nino to Puerto Salgar.

Both systems were constructed by using boats on the Magdalena River for access and hauling. Crews were camped in a houseboat. The Magdalena River, one of the world's largest, shifts its banks regularly, making pipeline cross-

In early stages of construction when this picture was taken, the station at Dindal was completed last fall.

Station under construction at Guaduas on Salgar-Bogota expansion.

Living quarters at Guaduas.

Another view of the station at Guaduas.

ings difficult to construct and maintain.

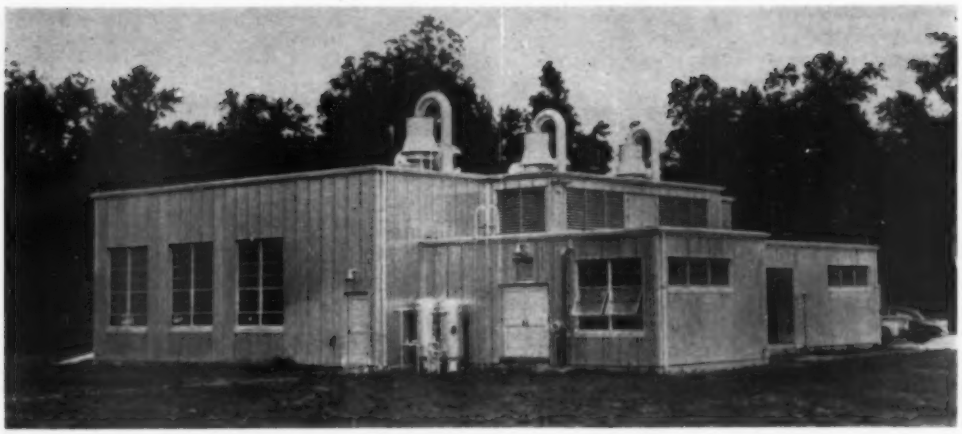
Williams Brothers also designed and constructed a pipeline system to transport products from Puerto Salgar to Bogota — a 6-in. line 187 kilometers (117 miles) long. This pipeline rises from the jungles of the Magdalena Valley to rugged mountainous terrain, terminating at the Bogota tank farm about 9000 ft in elevation. The system is presently being expanded. Construction materials are barged up the Magdalena River about 1500 kilometers (937 miles) from the seaport of Barranquilla. Such hauls require six weeks in transit.

Accompanying photographs depict various facets of the present Salgar-Bogota expansion. In addition, a route map is shown. Pumping stations exist at Puerto Salgar, Guaduas, and Alban to transport aviation gasoline, motor gasoline, diesel fuel, kerosine, and LPG to the Bogota terminal. Present throughput corresponds to 8850 bbl per day based on motor gasoline.

Demand for refined petroleum products in the Bogota area is increasing steadily. Expansion of the Salgar-Bogota pipeline system will alleviate the Bogota shortage by increasing pipeline capacity to 12,300 bbl per day, based on motor gasoline.

Present expansion is being accomplished by adding one new pumping station to the system near Dindal and by adding a pumping unit and building extensions at each of the existing stations. The new station includes a pumphouse, generator house, and a combination office and storage building — similar to existing stations. Typical construction is shown by the photographs.

Local materials are used wherever possible. All supervisory personnel for construction are expatriates from the United States, whereas most craftsmen and all laborers are hired locally. ★ ★



Port Barre station is one of two completely automatic engine-driven pumping stations on the Evangeline Products System.

P 615.5

One Station Controls Entire System's Operation

Expansion gives Evangeline Products System three satellites, one master station, and an increase in capacity to 170,000 bbl a day

M. U. Bagwell
Chief Engineer
The Texas Pipe Line Company

SATELLITES are much in the news these days and the pipeline industry has its own particular brand. Satellite stations — those unattended and fully operated from a remote point — have been in use on a few systems over not too long a period of time, but are steadily gaining in favor. Evangeline Products System has recently added two such stations.

Evangeline is unusual in one respect. With only four stations on its entire system, three are satellites.

The new stations, at Port Barre and Jennings, Louisiana, feature three 1720-hp, 4-cycle dual-fuel diesels* at each location. Original stations at Port Arthur and Lake Charles are electrically powered, with Port Arthur the master station from which the other three are controlled. Jennings station has been on pushbutton control since July 1956; Port Barre was placed in operation last February.

The dual-fuel engines are 8-cylinder units with 13-in. bore and 16½-in. stroke operating at 500 rpm. Each engine drives a 4-stage centrifugal pump rated at 4410 gal per min at 1400-ft TDH through step-up herringbone gears, with ratio of 500 to 2402 rpm.

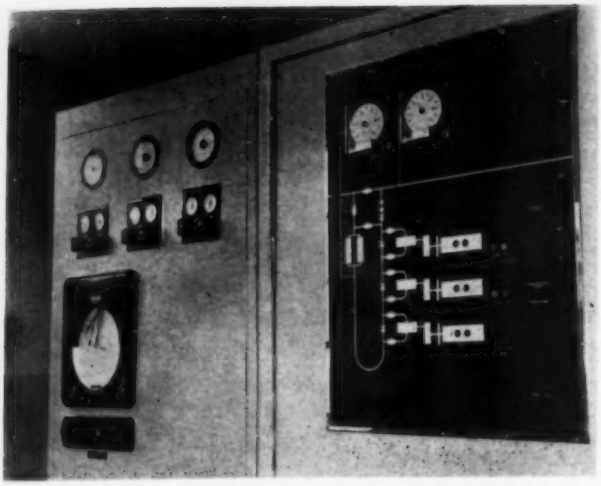
The expansion program has increased pumping capacity to 170,000 bbl per day for this 189-mile, 16-in. pipeline system between Port Arthur, Texas, and Baton Rouge, Louisiana. Currently this is in excess of requirements, but allows for anticipated growth.

Putting a Satellite Station Onstream

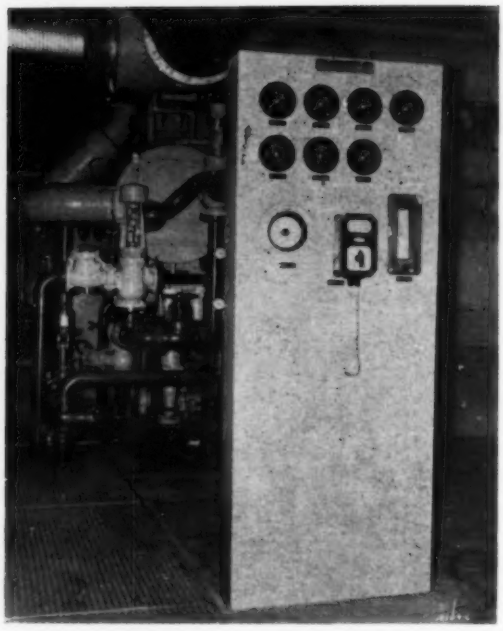
When a satellite station is put onstream, the operator at Port Arthur first checks the line pressure at the satellite station, which is telemetered to the central control panel. He presses a button to open the station suction valve and another that closes the station main line back gate, thus routing the full stream into the station loop. Another button is then pressed to activate the station start sequence. Pump room ventilation blower, crankcase vent blowers, and auxiliary lube oil and engine cooling water pumps all start about five minutes before the engine is started. Meanwhile suction and discharge valves to main pump are opened.

After the 5-min lapse of time, a starting air solenoid-operated valve opens and the engine starts on diesel fuel. When it comes up to idling speed, water pump pressure opens the circuit on the solenoid valve and shuts off the starting air supply. After 5-min of running idle, the line controller goes into operation and permits the engine to speed up to the rpm required by incoming and outgoing pressure. A pneumatic controller speeds up or slows down the engine to maintain minimum suc-

*Nordberg Supairthermal Duafuel diesels.



Every function of the satellite station is revealed on a panel by the use of a system of colored lights. The board is duplicated at the master station at Port Arthur and the operator there can exercise full push-button control.



Although no operator is ever on duty, each engine has a gage panel for use by maintenance men during scheduled checks on equipment.

tion pressure or limit discharge pressure within the permissible speed range. When the engine has been running long enough to bring the lube oil temperature up to 140 F, the engine automatically goes on dual-fuel operation.

Should an engine fail to start, the starting air solenoid is re-energized for 4 seconds and closes for 20 seconds for a second try. This is repeated a third time, and if no start occurs, a shutdown relay is energized and shuts down and locks out the unit. Two engines can maintain full line capacity at each of the two stations. Procedure for starting and going onstream is of course the same for all three engines at both of the new stations.

After the first unit starts operating normally, the Port Arthur operator starts another one with the same sequence. When the suction valve on the second unit is opened, the first engine slows down permitting the suction pressure to build up briefly while the second unit starts and in 5 minutes the speed of both increases and the units are then put under the same pneumatic control. Similar procedure occurs when the third unit goes onstream.

Control Protection While Operating

During operation, each of the pumping units is under control protection against engine overspeed, excessive jacket water temperature, low lube oil pressure, vibration, high bearing temperature at four points on the gears, excessive leakage at two points on the pump seals, high temperature of pump bearings at two points, and high temperature of the pump case at one point.

Station protection is provided against stoppage of the ventilating blower, low suction pressure, abnormally high discharge pressure, and leakage of products spilled on the floor. Spillage is carried via drains to the sump, which is equipped with a float and switch to actuate emergency shutdown devices if leakage becomes serious.

To protect the pump against high temperature and seal leakage, a common pneumatic system of copper tubing and air supply connects all nine points of protection and one mercury switch in the auxiliary room responds to all of these points. A vibration switch on each engine comes into operation automatically after the engine converts to dual-fuel operation. When the engine shuts down, a spring and lever arrangement recocks the vibration switch in case it tripped during shut down.

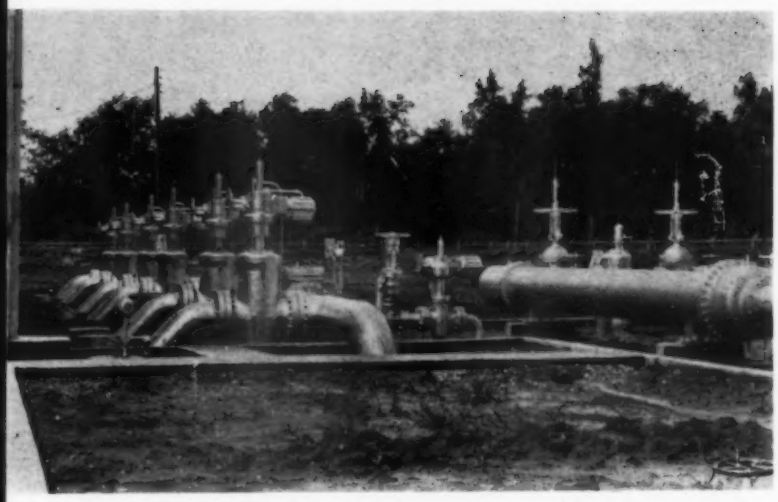
There are two 3-way water temperature control valves on each unit. One valve maintains the jacket water temperature at 160 F and the other valve keeps the turbocharger air in the manifold at a constant temperature of 100 F. Jacket water is cooled by a shell-and-tube heat exchanger in the products stream entering the station. About a third of the cooling water in the closed system is routed through the lube oil and turbocharger coolers and back into the flow to jackets of the engine.

There is a scraper detection unit in the main line permitting the pipeline scraper to by-pass the station automatically. An incoming scraper triggers the controls so that the pumping units slow down while a by-pass opens between suction and discharge lines. The station block gate opens and the suction valve closes. After passing the block gate, the scraper triggers a second detection unit causing the valves to become realigned

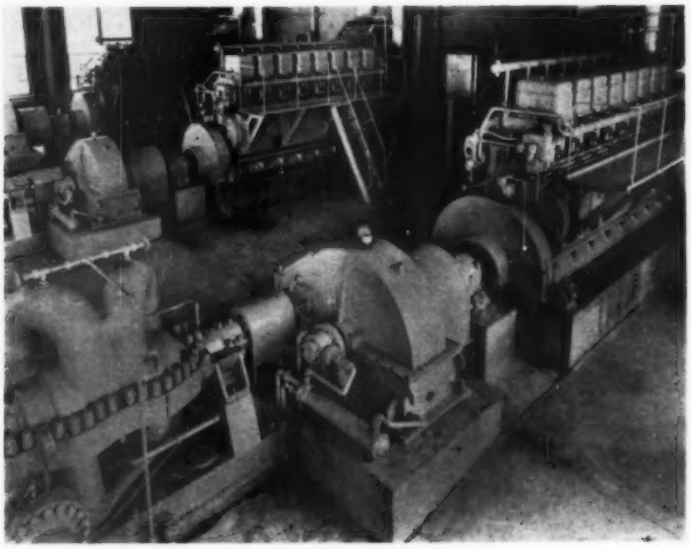
THE AUTHOR

M. U. Bagwell *was graduated from Texas Technological College in 1934 and Texas A & M in 1936 with a degree in mechanical engineering. He joined Texas-New Mexico Pipe Line Company in 1937 and worked as field engineer, master mechanic, and assistant division manager. In 1954 he became chief engineer of The Texas Pipe Line Company.*

P 625.4



All valves controlling flow of petroleum products to and from the automatic stations are outside the main engine-pump station building and are remotely controlled from Port Arthur.



Three dual-fuel engines, which rated 1720 hp at 500 rpm, operate unattended in two of the satellite stations. The engines drive centrifugal pumps through step-up gears.

to original operating position and the engines resume normal speed.

Control Panel the Trouble Indicator

Unit operation, valve lineup, unit electrical trouble, or mechanical trouble is indicated on a control panel located inside the control room. This board is duplicated at the master station at Port Arthur. The signals come in over the supervisory system and indicate operating information at each location.

Signals come in over the company's own telephone system. Different signals can be sent simultaneously in both directions over a single wire. Should a storm knock down the telephone lines, the plant will continue operating automatically so long as nothing goes wrong, pending repairs on the line to Port Arthur. Should anything go wrong with an engine, pump, or gear set, the complete pumping unit will close down and lock out until an attendant comes to the station and corrects the trouble. This occurs independently of the signal system to the master station.

So long as there is no line trouble due to storms or other causes, the operator at Port Arthur can determine the cause of any trouble in either station as revealed on the telltale panel and can relay this information to the serviceman sent to the trouble area.

The stations at Port Barre and Jennings are steel structures with prefabricated framing and paneling insulated with glass fiber and covered inside with perforated acoustic board. They are permanent buildings and therefore built to the highest standards of quality. A single large engine room houses all three pumping units and has a gantry crane overhead for repair service. There are three other rooms. One of these houses the entire signal and control systems. In another there is a 50-kw emergency generating set and the third room is equipped for routine maintenance. The plant is surrounded by a high fence of galvanized link mesh.

During periods when diesel fuel oil is being transported, liquid fuel is received from the main line and stored in a 2000-bbl tank at the station. Pipelines, valves, heat exchangers, fuel storage tank, sump and sump pump, temporary jacket water storing and utility tank, and the pump house for the well pump supplying plant water are all outside the main structure. Well water is treated before use as makeup.

Since each of the engines has its own oil and water pumps, it operates independently of an outside source of power once it is started and running. The before and after pumps act as standby units.

There is an instrument panel for each engine with gages showing the pressure on engine lube oil, turbocharger oil, fuel oil, jacket water, gas starting air, and turbocharger air. It is equipped with exhaust temperature pyrometer.

The main pumps and gear sets each have their own lubricating system including oil pumps, oil coolers, and filters. Therefore, their operation is not affected by conditions prevailing within the driving unit.

Electric power, however, is essential to plant operation. A major requirement is engine room blower operation. If the ventilating system fails, the plant automatically shuts down and locks out because products pumped may be highly volatile and pump leakage could bring about an explosive mixture. Every precaution is taken to prevent explosion or fire.

The Evangeline Products System is owned in undivided interest by Gulf Refining Company, Sinclair Pipe Line Company, and The Texas Pipe Line Company and is operated by The Texas Pipe Line Company. The engine and pumping installation in the two new stations, their design, construction, and method of operation are symbolic of the imaginative engineering and the advance made in recent years by the pipeline industry of the nation. ★ ★

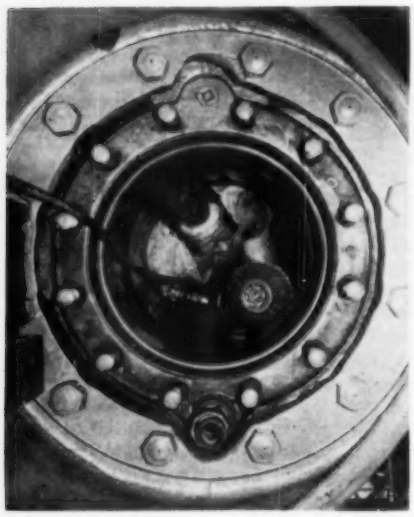
maintenance

Station Superintendent Cy Schaulis, left, Master Mechanic Phil Going, center, and Oiler Jerry Callaway, right, check to make sure the ring fits properly into a regrooved piston.

Master Mechanic Phil Going, inside a compressor cylinder, gets the exact measurement between cylinder walls, which have been buffed clean.

A COMPRESSOR STATION IS OVERHAULED

Oiler Bob Boll uses a buffer to clean up the inside of a cylinder.



Oilers William Robly and Herman Becker replace a cylinder head.

Maintenance Helper Dennis Engdahl gives the flywheel a coat of paint.

Maintenance Helpers Alman Fellows, foreground, and Dennis Engdahl, background, grinding intake valves.

Northern Natural Gas Company has a definite program of maintenance to keep its compressor stations in good repair. Approximately half of its compressors undergo complete overhaul annually and the other half are inspected and minor repairs made when found necessary.

These pictures were taken at the Hooper, Nebraska, compressor station and the engines involved in the overhaul were 850-hp units. Work was done under the supervision of Master Mechanic Phil Going.

Oiler Willard Schulz removes a compressor valve.

A crank bearing is being removed in the foreground while a main bearing is tightened in the background. Left to right: Yardman Dallan Peiper, Maintenance Man Ed Peterson, Master Mechanic Phil Going, and Maintenance Man Jim Ott.

A 10-ton overhead crane moves a piston to the cylinder where it is replaced.

IDEAS AT WORK

IDEAS AT WORK

TOOLS DO THE JOB BETTER

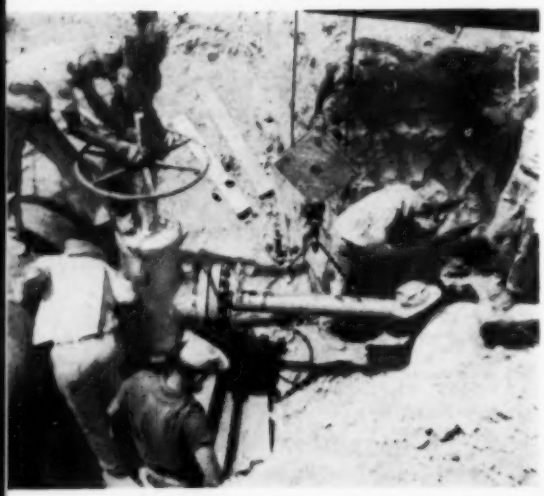
They save labor, time, money . . . and are safer

SUCCESSFUL day-to-day pipelining operations are characterized by efficiency. When tools prove to be safe as well as labor, time, and money savers, they ensure this efficiency.

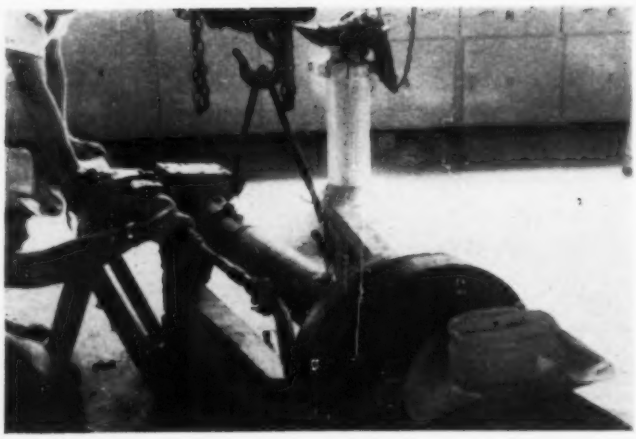
A good tool reduces the number of men required for a given job, releasing them for other jobs, and getting more done overall. In the big picture this enhances the prosperity of all.

A case in point is the tapping machine. Formerly tapping required several men to work at an exhausting pace cranking the cutting head by hand. The tapping machine is now

Shop-made hoisting device is operated by wheel tractor's hydraulic system. Pipeliner's ingenuity is local modification and moves heavy loads safely.

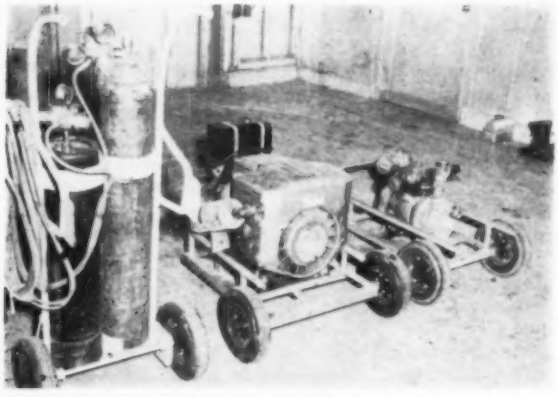


Before and after. (Above) Field crew hand-operating tapping machine. Milling shaft is enclosed in sleeve extending from valve to right. Man hand-cranking the shaft as it mills through tough pipe steel could work only about two minutes before tiring. (Right) Tapping machine powered by air motor in warehouse test. Man controls air motor speed with one hand and the job becomes a one-man operation.



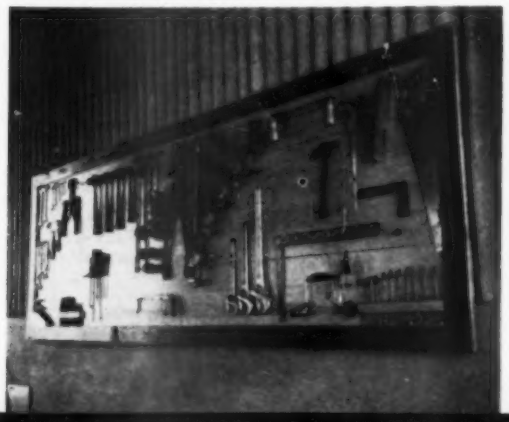
Traveling crane on rail, supported by extension legs, moves cylinder head weighing 500 lb. One man now easily and safely moves the cylinder head, a job formerly requiring the labor of three or more men. Automatic valves require periodic servicing.

A light utility truck upon which is mounted a front-end power winch, can be used to remove brush and trees from the right-of-way. Two men can do the work that once took a much larger crew. A truck equipped in this manner also can pull itself through deep mud, as it is doing here.



Small wheels are used for ease and safety in moving conventional pipeline items. This grouping includes, from left to right, an oxyacetylene welding cart, portable generating plant, and small water pump.

A board upon which commonly used tools are neatly and conveniently arranged, is a great time saver.



equipped with an air motor, allowing it to be operated safely and easily by one man.

A power winch mounted on the front of a small utility truck and driven by the truck's transmission, now clears brush and trees from right-of-way, something that formerly required the labor of several men. Anchored to a firm support the vehicle also can pull itself through deep mud.

A shop-made hoisting device attached to the rear of a wheel tractor and operated by its hydraulic device, now does the lifting of several men — safely.

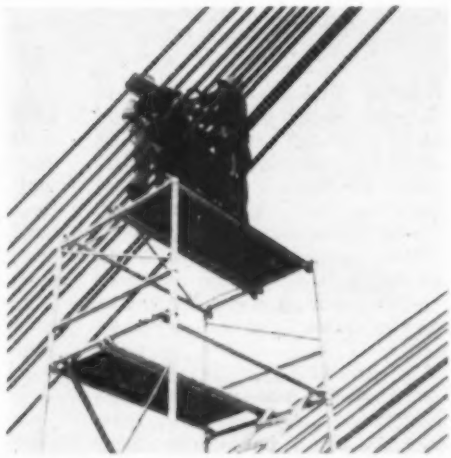
A portable traveling crane permits one man to move easily and safely a 500-lb cylinder head, an operation required in the periodic servicing of automatic valves.

In addition to their use with tapping machines, air motors are utilized in operating drills, tampers, scrapers, sanders, and many other tool types where previously the work had to be done by hand. Use of an air motor in these devices provides extreme flexibility in that they can use a portable air compressor as the source of power.

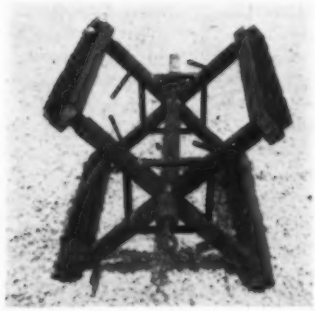
In addition to the economies of time and money, such labor savers result in improved job morale and a reduction in on-the-job accidents.

For photos and text material thanks to *Between the Lines*, company magazine of Texas Illinois Natural Gas Pipeline Company and Natural Gas Pipeline Company of America.

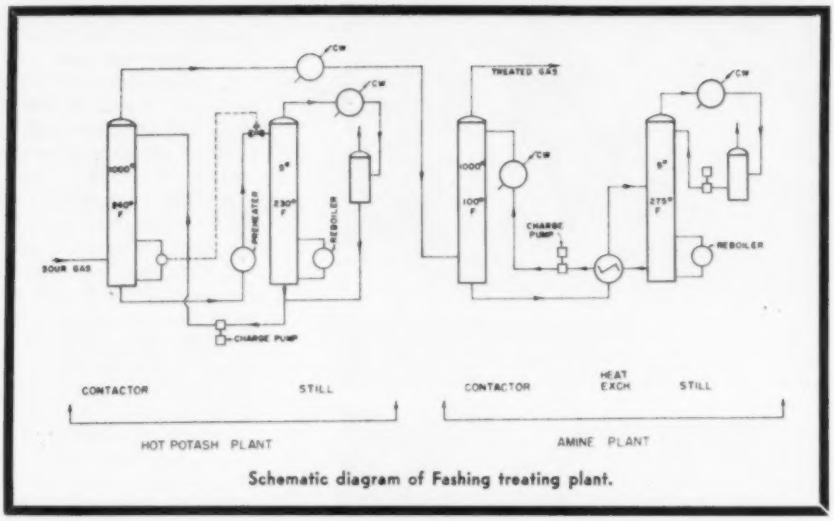
* * *



Portable scaffolding provides elevated work platform at suspension cables on pipeline bridge. The tubular steel scaffolding is easily assembled by two men to provide a safe working space. Note safety belts used by workmen.



Shop-fabricated internal brush for cleaning 30-in. OD pipe. The brush is rotated in the pipe by an independent power unit directly connected to the brush. Work previously was accomplished by hand-scraping and was extremely slow and tedious.



Schematic diagram of Fashing treating plant.

Gas Treating by NEW METHOD

ONE OF THE COUNTRY'S first plants to use the hot potash-amine method of treating natural gas is being built by the Lone Star Producing Company in the Fashing (Edwards lime) field of Atascosa County, Texas, about 50 miles southeast of San Antonio.

Construction of the plant, which will also dehydrate the gas, got underway in mid-January, according to Julian L. Foster of Dallas, Lone Star vice president.

The plant will cost approximately $3,750,000. Ten dually completed gas-distillate wells, each owned by Lone Star, will supply the treating plant, which will remove acid components and water from the sour gas and make it suitable for burner tip consumption. The wells will be produced from the upper and lower Edwards lime.

Gas produced in the field contains 6½ percent carbon dioxide and 2 percent hydrogen sulfide. Foster said the hot potash method of removing acids from the sour gas, used by the petrochemical industry for some time, only recently has been adopted by the natural gas industry. Advantages of this process over conventional methods, he said, are lower fuel requirements, less investment, and lower maintenance costs.

Foster pointed out that the hot potash-amine method of removing acid components makes it economically sound to treat sour gas, which otherwise might be flared into the air and wasted. He termed the method a big step forward in the conservation of natural petroleum resources.

The plant, largest of its kind ever undertaken by Lone Star, will have capacity to deliver 100,000,000 cu ft of treated and dehydrated gas daily. Daily availability of the 10 wells to supply the plant is estimated at 125,000,000 cu ft. The Fashing field has reserves estimated at over 400 billion cu ft.

The plant will consist of an inlet separator for distillate removal, flow tanks, a hot potash system that will remove 90 percent of the acid components from the gas, a conventional amine system for removing the remaining 10 percent of the acid components, and a solid bed type dehydration plant. The hot potash and amine systems consist of contactors, stills, boilers, electric generating facilities, cooling tower, pumps, and other equipment.

Liquid production at the Fashing field plant for the present will be limited to separator distillate, Foster said; however, he added, it is contemplated that within the life of the field, compressor, gasoline extraction, and sulfur production facilities may be added.

Lone Star in November announced completion of a 20-year contract with the United Gas Pipe Line Company for sale of the Fashing field gas. Delivery from the Lone Star properties to United's intrastate pipeline system is scheduled to begin in about six months upon completion of the plant.

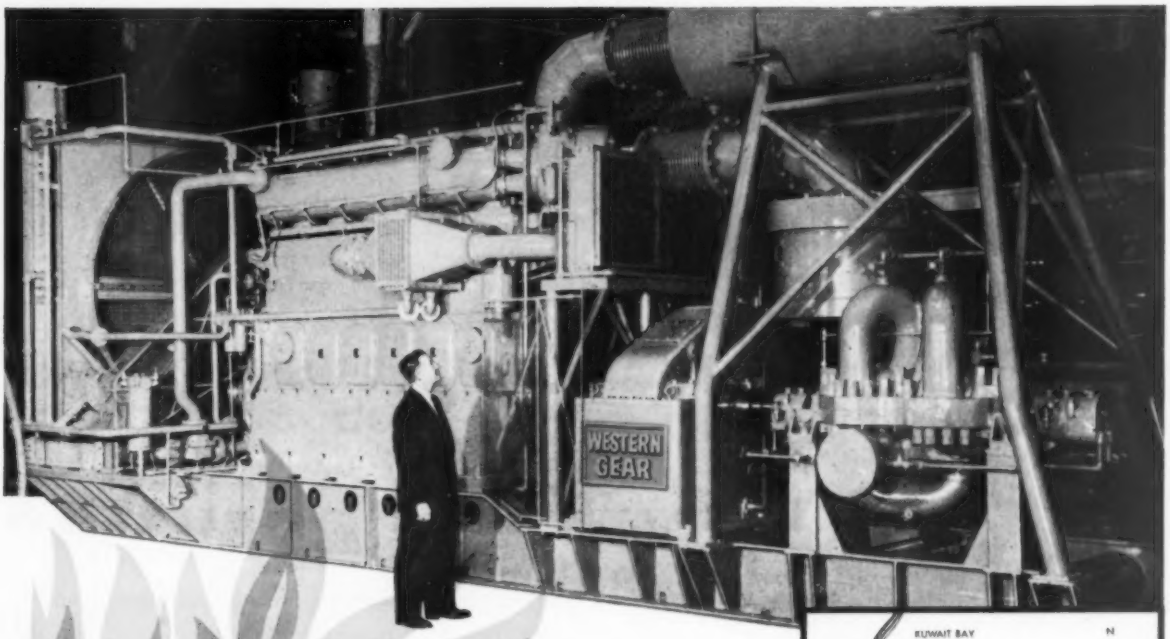
It has been estimated that Lone Star's gross revenue from sale of gas and condensate from the Fashing field will approximate between $4,000,000 and $5,000,000 annually, based upon an anticipated daily average delivery to United in the range of from 50,000,000 to 65,000,000 cu ft of gathered, sweetened, and dehydrated gas.

Lone Star will build a five-mile gathering system to deliver the gas from the wells to the treating plant. It will be constructed by the transmission division of the Lone Star Gas Company, the producing company's parent organization. Plant operating personnel consisting of about 12 men will be announced in the near future.

The plant is to be erected on a 60-acre site in the John Benson survey of Atascosa County. Water for the plant will be obtained from wells on or near the plant site. Conventional automatic safety controls will be installed throughout the plant.

Graff Engineering Corporation of Dallas engineered and designed the gas treating facilities for the Fashing field plant. Contract for plant construction and installation of operating facilities has been let to the Gasoline Plant Construction Corporation of Houston.

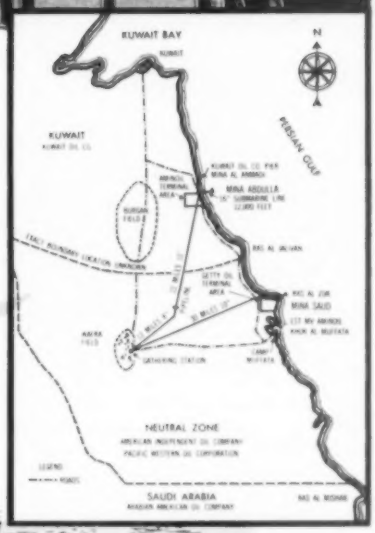
Lone Star Producing Company's No. 1 L. T. Urbanczyk, a gas distillate discovery, was completed in August 1956, and marked the opening of the Fashing field. Gas wells in the field are not connected to Lone Star's transmission system. ★ ★ ★



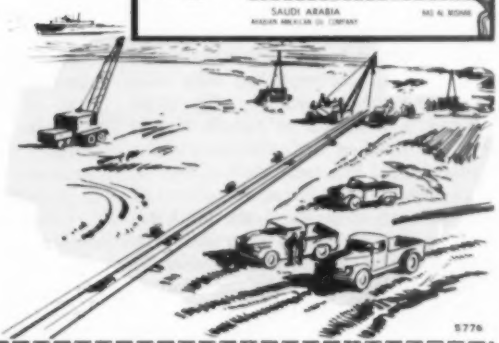
WESTERN GEAR

high speed units pump Arabian oil in sizzling 130 degrees

Pictured above is one of the four portable pumping units built by Enterprise Engine & Machinery Company, Division of General Metals Corporation, to pump oil for American Independent Oil Company in Kuwait. Western Gear high speed units were selected to boost a 600 RPM input to 3550 RPM output at 4 points along the 35 mile bleak, desert pipeline route.



Normal operating conditions under which these Western Gear Drives must function include 130 degree temperatures; fierce, sudden sand storms; bleak, inaccessible locations; changing production loads. It takes tough equipment to do a job like this. We build it tough, yet with uncompromising precision. Let us consider your power transmission problems.



5776

CALL THE WESTERN GEAR MAN!
Representatives in all principal cities.
Use this coupon to get his name and address.

"The difference is reliability" • Since 1888

WESTERN GEAR Corporation
ENGINEERS AND MANUFACTURERS

PLANTS AT LYNWOOD, PASADENA, BELMONT, SAN FRANCISCO (CALIF.)
SEATTLE AND HOUSTON — REPRESENTATIVES IN PRINCIPAL CITIES

Glenn Malme • WESTERN GEAR CORPORATION
P.O. Box 182 • Lynwood, California

Send me the name and address of my nearest Western Gear Man.

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

Westcoast Stations Designed for Cold Weather Operation

No. 1 station showing exhaust pipes; auxiliary housing in foreground, fire house at extreme lower left.

P 624.

Equipment enclosed in weather-proof structures having insulation-sandwich wall frame — Initially, system is pumping 400,000,000 cu ft a day

Leslie Orr Rowland

WORKING through a normal subzero northern Canadian winter to ensure completion of the job in the fall of 1957, two contractors were successful in beating a tough schedule on the construction of the first four compressor stations on the 649-mile 30-in. natural gas pipeline of Westcoast Transmission Company, Ltd. The line, Canada's first major gas export pipeline, started delivering gas early in October to Vancouver distribution systems and across the international boundary to the system of Pacific Northwest Pipeline Corporation.

Ultimate development of the Westcoast line will require eight compressor stations, but the initial throughput of approximately 400,000,000 cu ft a day is being accomplished with only the odd-numbered stations. The main station is designed to handle almost the first third of the entire line in the initial stage. The next station, No. 3, takes the load for about 40 percent of the distance, with No. 5, the third station, acting mainly as a booster. The fourth station, No. 7, is situated at the takeoff point for the Inland Natural Gas Company, Ltd., distribution system, which serves the interior cities and towns of British Columbia.

The main station was built by Stearns-Roger-Marwell, a joint venture of Stearns-Roger Engineering Company, Ltd., and Marwell Construction Company, Ltd. The other three stations were built by Dutton-Williams-Stearns-Roger, a joint venture of Dutton-Williams Brothers, Ltd., and Stearns-Roger. The plant division of Dutton-Williams handled the job for this firm.

Stations were all designed for cold weather operation. Nearly all operating mechanism at every site is totally enclosed in weather-proof structure of an ultra-modern type, including an insulation-sandwich wall frame.

No. 1 Station Handles Two Streams

Apart from the difference in size between the No. 1 station and the others, the main station also contains much greater complexity of equipment because it is designed to handle two streams. Gas from Alberta fields is dry and can go directly into the main line after compression. British Columbia fields produce wet gas, which has to be treated in a processing plant before it can enter the pipeline. Alberta gas therefore is segregated from the B. C. stream as it enters the compressor station.

Gas from the wet gas fields of British Columbia is gathered by three separate gathering systems. One comes from the Fort St. John field, which is only a short distance north of the main compressor station. Another comes from the southeastern sector of the Fort St. John field and ultimately will bring in gas from the Boundary Lake field to the northeast. Third and principal line is the main trunk gathering line, which collects gas from all the other fields, stretching out along the Alaska Highway to the north and west, and which is already being extended under a progressive program of additional construction.

No. 1 compressor station contains three input scrubbers for the sweet Alberta gas. After compression this gas stream flows back into the outgoing pipeline through two outlet scrubbers. British Columbia gas comes into the compressor station from all three lines in its raw state and is returned to the gas processing plant for treatment after compression.

Four coolers are provided for the outgoing gas, which reduce it from the 160 F temperature resulting from compression, to 100 F for normal specification temperature in the pipeline. These after-coolers are installed outside the compressor building and handle the gas before it enters the outlet scrubbers.

A station by-pass valve is provided upstream from the station, by which the higher pressure British Columbia gas can be routed directly into the pipeline without going through the compressor station during periods of low volume. This valve is controlled manually and is not expected to be used in normal operation. The volume of Alberta gas being handled initially has been about 160,000,000 cu ft a day, constituting the entire throughput of the main line, because of delay in completion of the gas processing plant which made it impossible to utilize British Columbia gas immediately after the start of operations early in October. Full use of B. C. gas through the station and the plant is scheduled for early 1958, with upward of 200,000,000 cu ft a day total throughput.

NOW...A BIG-INCH

520 TRENCHLINER®

Here's the Big-Inch 520 in action on a 650-mile, 30-inch pipeline in the natural gas fields of Northwest Canada. Experience on isolated, cross-country jobs like this has proved the 520's performance under toughest conditions of materials and terrain.

New 170 wide-wheel Trenchliner digs 20 to 32 inches wide, 5¾ feet deep. It has hydraulic wheel-hoist on power-tilt mast. Conveyor is hydraulically driven — belt speeds are independent of digging wheel speeds. Big Parsons line includes all sizes of trenchers — wheel-types, ladder-types — on crawlers, and rubber tires.

BIG THINGS HAVE HAPPENED since you last looked at big, wheel-type ditchers. New sizes have been added to Parsons line. First, meet the Big-Inch 520 Trenchliner — shown above. This wheel-type 520 digs 8½ feet deep, 40 to 52 inches wide — opens cross-country lines at speeds up to 28 lineal feet of trench per minute. And that's not all —

Also, a MIDDLE-INCH 420

Another big-wheel machine has joined the Trenchliner team — a Middle-Inch 420. It gives you digging depths to 7½ feet. Trench widths range from 31 to 46 inches. Depending on depths, widths, and job conditions, the 420 Trenchliner digs up to 44 lineal feet per minute.

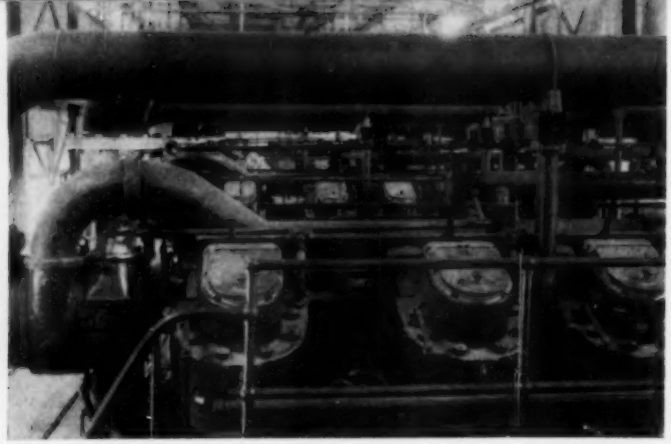
Both of these big, wheel-type Inchers have been thoroughly job-proved. They were originally developed by C-R-C, and now built by Parsons — bringing you the *combined* engineering know-how and services of both firms. Call us next time you're in the market for a big ditcher.

PARSONS COMPANY • Newton, Iowa

DIVISION OF KOEHRING COMPANY

P7376EX

TRENCHLINERS for PIPELINERS



Compressor bank, looking along tops of cylinders.

Part of suction and discharge manifold — suction lines from 26-in. main at left, discharge lines into 30-in. trunk at right.

The initial designed throughput capacity of 400,000,000 cu ft a day can be compressed by the six 2000-hp gas-driven reciprocating compressors, which are driven by 5000-hp engines operating on line fuel. The fuel gas system is situated in a corner of the main building, which houses the compressors and engines. All compressors are set on concrete block foundations and a block is poured and ready for a seventh unit when throughput requires it.

Suction lines are 10-in. diam and discharge lines 12-in. All are equipped with automatic valves operated from inside the building. The entire station is controlled from a single control panel.

A separate water pumphouse was built for the compressor station, to provide cooling water for the compressor jackets and for the aftercooling unit. Compressor jacket water is circulated in a closed system. Aftercooling water is carried in a large steel-frame tank.

Air, fuel gas, and instrument air lines are painted for easy and foolproof identification.

Special Foundation Design

Foundation design of the main compressor station was simplified by the unusual nature of the terrain. It is located near the north bank of the Peace River, a few hundred feet south of the gas processing plant, at Taylor, B. C. The whole river bank, for a depth of several hundred feet, is an uncompacted and perfectly clean gravel bed. An enormous gravel pit and mixing yard was established to the east of the composite plant site, and concrete was mixed here for all foundations.

Excavation was carried out to the depth required, and forms were set up on the gravel bottom. Excavation for the main compressor station building was six feet below grade, with the basement ceiling about eight feet high. All lines are carried under this ceiling, and the floor is solid concrete poured as a pad over the gravel base with reinforcing steel. Foundations of the compressors are isolated from the slab, so that a minimum of vibration is carried through the building frame.

Building construction is weatherproof, designed to protect against outside temperature as low as minus 40 F and winds of 25 mph. On the concrete foundation walls was erected an insulated metal-clad wall structure, consisting of an asbestos interior panel over steel framing, a two-inch layer of glass fiber between two sheets of transite for insulation, and an exterior wall skin of aluminum in large sheets nailed into place.

The engine auxiliary unit is combined structurally with the main compressor building for maximum economy in heating. The two portions of the building are separated by a solid concrete fire wall. The entire building is a modified "split level" design, with the main floor about 10 ft above grade and the height of this floor providing the extra ceiling height in the basement level without deep excavation.

Heating is supplied by a boiler hot water system, and engine exhaust heat is used as a supplement. All heating is by steam, three small boilers being used.

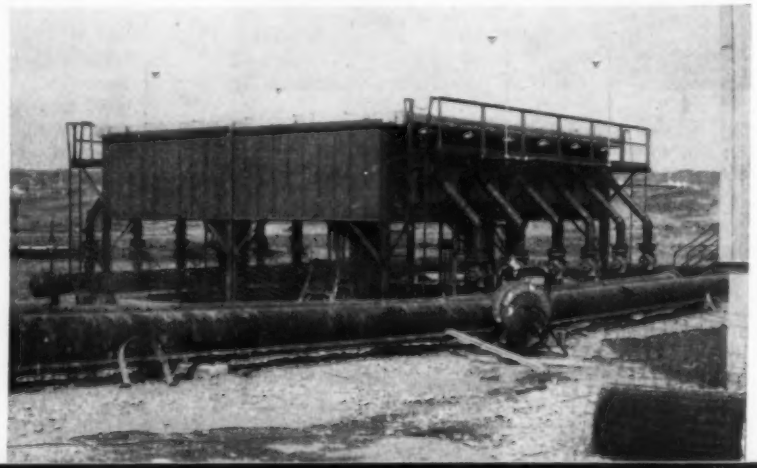
Engine cooling water is supplied by the return stream from the gas processing plant, drawn originally from the Peace River through the main pump house at the rate of 30,000 gal per min. This flow cools the circulating engine jacket water and lube oil through a system of shell-and-tube heat exchangers.

Electric power is provided by transfer from the processing plant, which has its own generating station.

Stations 150 Miles Apart

The down-the-line compressor stations constructed in the first stage are numbered 3, 5, and 7, spaced at approximately equal intervals of about 150 miles. All are equipped with 24 x 24 single stage centrifugal compressors of 2000 hp. No. 3 station at McLeod, at the western end of Pine Pass, and

Aftercooler unit.



Station by-pass valve under construction, showing unusual gravel bed terrain.

No. 5 station at Australian, approximately the half-way point on the line, have four units each, whereas No. 7 station at Savona, the Inland Natural takeoff point, is using only three initially.

All these compressors are driven by 3500-hp gas engines, supercharged, in series, utilizing straight-through compressor piping. "Fin-fan" forced draft air coolers were installed with complete housing because of the extreme weather conditions at the first two stations. There are automatic louvers on the roof and roll-up doors on the sides at all three installations. Speed increasers are used between engines and compressors.

Station No. 7 draws electric power from the local utility company lines as it is in the center of a heavily populated fruit-growing region tributary to the city of Kamloops 15 miles to the east. As a stand-by precaution, however, the station was equipped with a single unit gas engine-driven generator. Two of the same units were installed at each of the other stations on the line to provide electric power continuously, as they are both in relatively remote areas where public utility service is not available for enough load to run the stations.

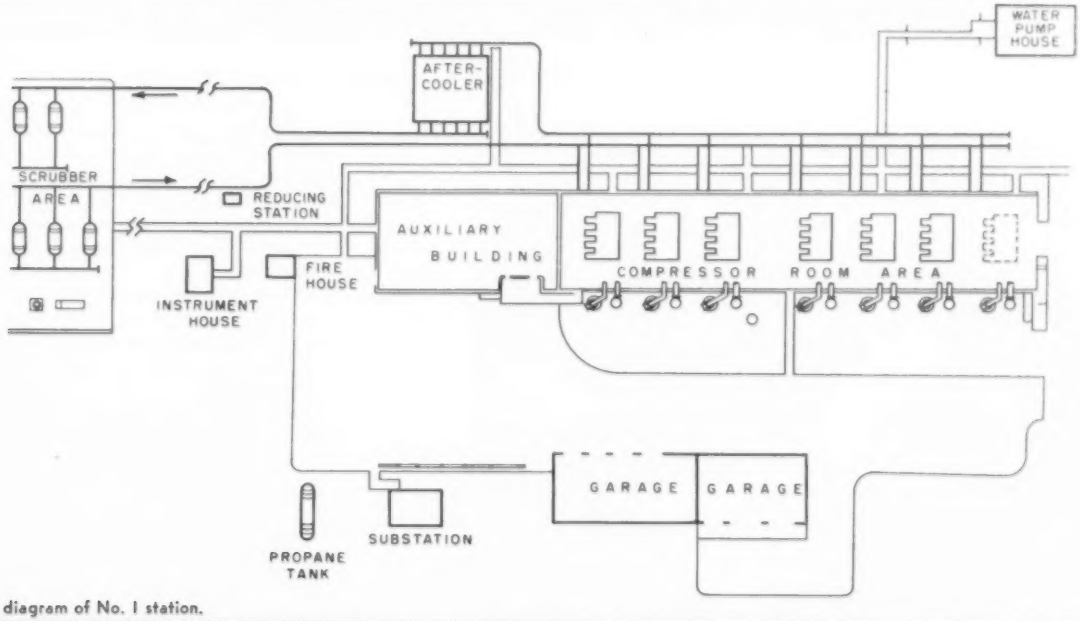
Each of the generating units consists of a gas engine, operating on line fuel, driving a 500-kw generator.

Foundations for No. 3 and 5 stations are in earth, clay, and gravel soil, with various strata and irregular bearing strength. Excavation was to several feet below floor level of the basement in each case and a compacted gravel bed was tamped in to provide a base for the concrete floor and the engine and compressor foundation blocks. As in the case of No. 1 station, the machinery bases are floated independently of the building foundations to minimize vibration.

No. 7 station is in the desert country on a sage-brush flat with sand-clay subsurface, and straight excavation was done here without extra padding on the bottom. Although the climate is more moderate than farther north, the same structural design was used for uniformity and in order to give protection for temperatures that sometimes fall to near zero.

Construction work started in the late summer of 1956 at all sites, and the emphasis was placed on getting foundations completed and building framework up before the severe winter weather started. Thus, interior work on piping and installation and pouring of interior floors could go ahead all through the winter with almost no interruption. Electrical work also proceeded all winter in the heated buildings. No. 1 station was essentially completed by the end of July 1957, No. 3 and 5 were in operation by the end of the summer, and No. 7 by early fall to coordinate with the later completion of the Inland line on which the final tie-in was not made until near the end of October.

All construction crews were housed and boarded on site, as no public ac-



Flow diagram of No. 1 station.

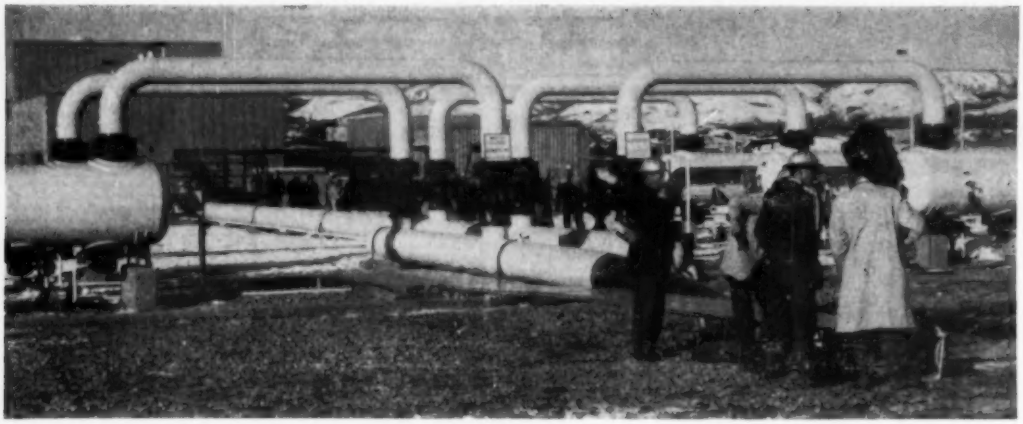
Foundation construction for the compressor building, showing independent concrete piling for machinery to reduce vibration.

commodation was available in the immediate vicinity of any of the stations. The contractor provided camp buildings at each site and subcontracted the catering.

Transportation of materials and equipment to the site was more of a problem than any on-site construction methods, as rail service was not available to either No. 1 or No. 3 station. No. 1 station received its supplies from the railhead at Dawson Creek, over the Alaska Highway by truck service, and No. 3 was serviced in the same way over the John Hart Highway from the railhead at Prince George to the south.

Hauling Heavy Equipment

Truck transportation was used for the most part to move the engines and compressors. Because of load limits on the Alaska Highway bridges, two lowboys had to be used for this type of heavy equipment, which could not be

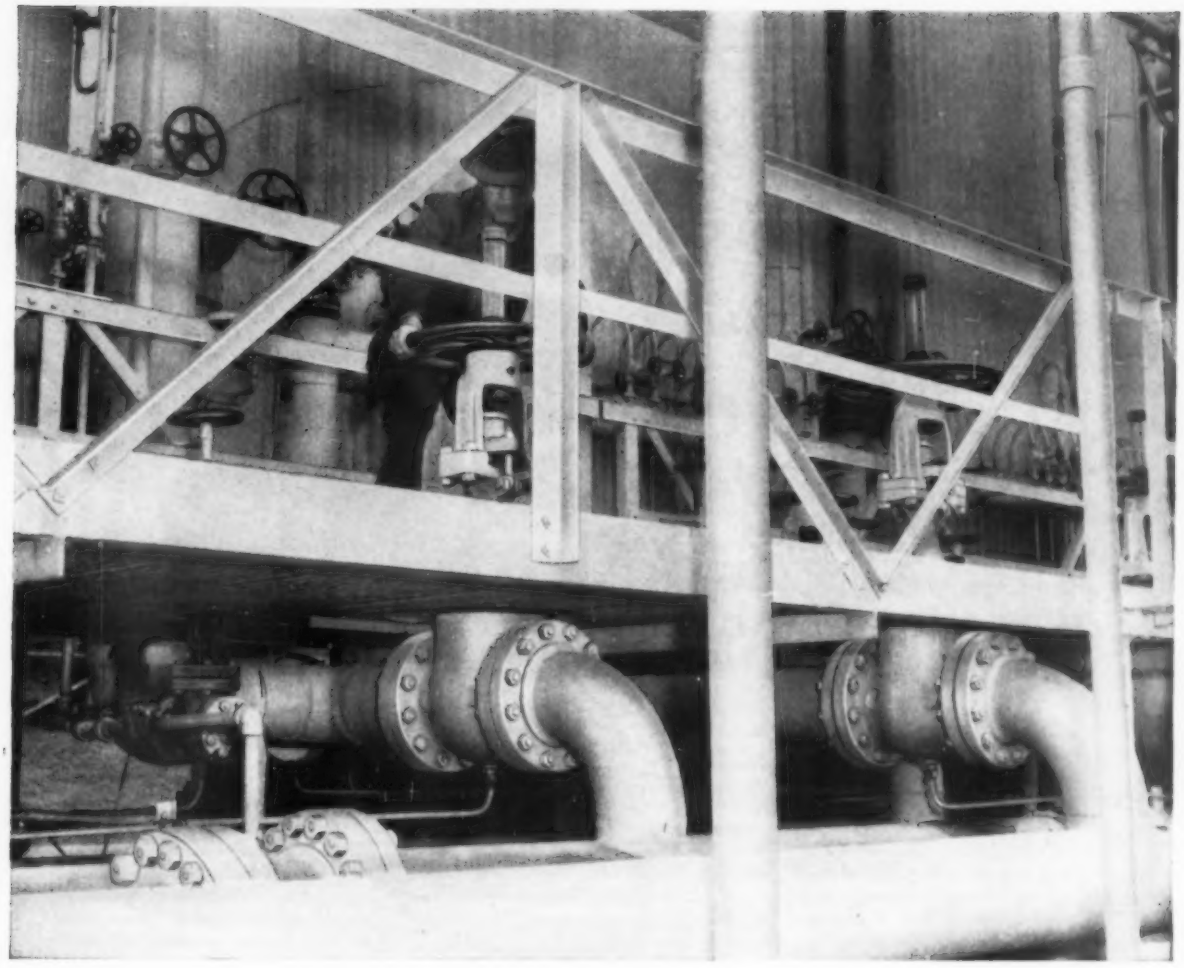


Official opening — completed scrubbers in background.

Official opening — control valve on outlet scrubber to main transmission line.

dismantled. One truck moved forward, while the other traveled behind it in reverse, so that the load could be distributed between the two beds. Obviously, it was a slow job, complicated most of the time by snow and icing conditions.

Reduced width and steeper grades on the John Hart Highway, combined with the heavier snowfall and worse icing, resulted in an unusual approach to the transportation of heavy equipment. Compressors and engines for No. 3 station were hauled on big sleds, each pulled by three heavy tractors. One tractor was used for normal pulling, an extra tractor was added at the front end and for steep upgrades, and a third tractor was winched on the back end of the load to hold back on downgrades. Average hauling speed was 12 miles per day with this combination of motive power. ★ ★ ★



Double Block Protection at Half the Cost —with Crane Flexible Wedge Disc Gate Valves

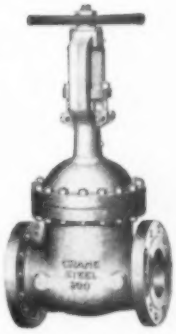
There are real savings in this installation.

The main valves you see in the photo are Crane 33XU steel gates modified with flexible disc—8-, 6- and 2-inch—on the dehydrator in the Phillips Pipeline Company pump station at Borger, Texas. Moisture is removed from the product here, using butane at 450° F. The setup is part of Phillips' 8-inch Borger-Chicago product pipeline, looped in 1951 to handle dissimilar products.

Design features of the Crane flexible wedge disc gate valves are cutting costs across the board. With the flexible disc, positive seal is assured on the upstream as well as downstream side. Each valve does the work of two with solid wedge disc.

Tapped opening is provided in bottom of body which permits bleeding while main valve is closed. Valve and piping costs are cut in half; the operator has only one valve to handle instead of two.

Crane flexible wedge disc steel gate valves can be furnished in sizes 2- to 12-inch, pressure classes up to 1500 lb. Get the facts from your local Crane Representative, or write to address below.



CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

P 615.04

Survey and staking crew, using a marsh buggy and pontoon sled, stake a straight path across the Louisiana marshland.

FIRST Ethylene Pipeline Built for Interstate Shipments

Special problems of construction, metering, and pressure reduction solved for handling this high purity product

CONTRACTORS are now completing work on the first interstate pipeline to transport high purity ethylene. This line extends from the Lake Charles, Louisiana, plant of Petroleum Chemicals, Inc., to its contract customers in the Orange, Texas, area. These will include E. I. duPont de Nemours and Company, Inc., and Spencer Chemical Company.

Petroleum Chemicals, Inc. is completing a plant capable of producing 200,000,000 lb of ethylene per year by cracking gases delivered from adjacent petroleum refineries of Cities Service and Continental Oil companies. Plant is designed in such a way that it is readily expandable to 300,000,000 lb per year production. The Lummus Company is the general contractor for plant construction.

The pipeline has been constructed of 6⅝-in. OD pipe and will operate at a pressure of 1000 psig although withdrawals will be made at 450 psig or less.

Variation in pressure on this system will permit use of the pipeline as a storage facility. At times when deliveries are small the plant at Lake Charles can pack the line to 1000 psig and provide extra capacity for times of abnormally large deliveries or for occasions when it is desirable for the Lake Charles plant to be down for a short period of time. Such surge capacity will permit continuation of normal deliveries during these periods even though no ethylene is being delivered to the pipeline at Lake Charles.

To keep in constant touch with pressure conditions at the Orange, Texas, end of the pipeline a pressure transmitter has been installed at Orange that telemeters pressure, over a leased telephone channel, to a recorder mounted on the control panel in the ethylene plant at Lake Charles, Louisiana. To supplement this, a full period talking channel between Lake Charles and Orange has been leased to provide contact between manufacturing and delivery points at all times.

Aerial photography was used to determine the route of the pipeline. As the line is a private facility the problems of acquiring rights-of-way had to dictate the exact route. Terrain traversed by the line is flat farmland and marsh. The line is about 30 miles in length and of this 30 miles, about 12 miles is marshland. It was necessary to use a marsh buggy, pontoon sled, boats, 2-way radios, and other out-of-the-ordinary equipment in order to stake across the marshland. A 20-ft high wood tower was constructed at one end of the marsh for the instrument man in order to see over the vegetation in the marsh and direct line of stakes. Nearly eight miles of the alignment of stakes were controlled from the one tower, which is quite a distance considering visibility conditions in the Gulf Coast area. The staking operation required considerable preparation, but the 12 miles of marsh were actually staked in two working days.

Problems of Marshland Construction

Marshland construction presents many problems not normally encountered in ordinary cross-country pipeline construction. In some areas of the marsh the contractor was able to take stakes 14 ft long and push them completely into the marsh with practically no effort. This created a problem of possibly adding weight to the line to keep it from floating. (The specific gravity of the ooze encountered in the marsh varies from 1.10 to 1.15.) By using pipe of ¼-in. wall thickness with proper coating, a specific gravity of about 1.179 was obtained, using an empty closed line. This kept the pipe from floating in the ooze and at the same time was not so great that it might continue to sink into the ooze, which could result in additional stress in the pipe.

The Sabine River and several navigable canals and bayous were crossed by the line. The Sabine crossing was in-

For Complete FREE Information on—

- NEW EQUIPMENT
- LITERATURE
- ADVERTISED PRODUCTS

Let us help keep you alerted to the newest in equipment and services in your fast changing industry.

1. For more information on ***Advertised Products*** or ***Services*** in this issue . . . list the page number of the advertisement and name of the advertiser.
2. For more information on ***New Equipment, Catalogs*** and ***Sales Literature*** reviewed in this issue, circle the code number on the card below corresponding to the code number of the New Equipment or Literature item.
3. Then print or type your name, title, company and complete mailing address . . . detach and drop in the mail.

LIST HERE for more information about ADVERTISED PRODUCTS . . . . .

CIRCLE NUMBERS for NEW EQUIPMENT AND LITERATURE items . . . . . .

Send me further details on PRODUCTS or SERVICES ADVERTISED on pages I have listed below.

Page_____ By_____ Page_____ By_____

Page_____ By_____ Page_____ By_____

Page_____ By_____ Page_____ By_____

Page_____ By_____ Page_____ By_____

Circle code number corresponding to NEW EQUIPMENT or LITERATURE items following in this issue.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	39	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120

Please print or type below. ☐ Please send me index of 1957 content.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

2 Void after 90 days February, 1958

Postage Will Be Paid by Addressee

POSTAGE STAMPS REQUIRED IN COUNTRIES OTHER THAN U. S. A.

No Postage Stamp Necessary If Mailed in the United States

Use these Ready-Reply Cards for prompt action on your request.

BUSINESS REPLY CARD
FIRST CLASS PERMIT No. 1091, DALLAS, TEXAS

the Petroleum Engineer
PUBLISHING COMPANY
P. O. Box 1589—DALLAS, TEXAS

For Complete FREE Information on—

- NEW EQUIPMENT
- LITERATURE
- ADVERTISED PRODUCTS

1. For more information on ***Advertised Products*** or ***Services*** in this issue . . . list the page number of the advertisement and name of the advertiser.
2. For more information on ***New Equipment, Catalogs*** and ***Sales Literature*** reviewed in this issue, circle the code number on the card below corresponding to the code number of the New Equipment or Literature item.
3. Then print or type your name, title, company and complete mailing address . . . detach and drop in the mail.

These Ready-Reply Cards bring you fast action for information on the new equipment and service items listed . . . and complete information on the products and services advertised in this issue.

Postage Will Be Paid by Addressee

POSTAGE STAMPS REQUIRED IN COUNTRIES OTHER THAN U. S. A.

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
FIRST CLASS PERMIT No. 1091, DALLAS, TEXAS

the Petroleum Engineer
PUBLISHING COMPANY
P. O. Box 1589—DALLAS, TEXAS

Send me further details on PRODUCTS or SERVICES ADVERTISED on pages I have listed below.

Page_____ By_____ Page_____ By_____
Page_____ By_____ Page_____ By_____
Page_____ By_____ Page_____ By_____
Page_____ By_____ Page_____ By_____

LIST HERE for more information about ADVERTISED PRODUCTS

Circle code number corresponding to NEW EQUIPMENT or LITERATURE items following in this issue.

CIRCLE NUMBERS for NEW EQUIPMENT AND LITERATURE items

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	39	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120

Please print or type below. ☐ Please send me index of 1957 content.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

February, 1958 Void after 90 days 1

PUBLISHING COMPANY
P. O. Box 1589—DALLAS, TEXAS

Pontoon sled is pulled across one of several water channels crossed by the pipeline. Constant communication by 2-way radio was maintained between marsh buggy and control tower.

Closeup of marsh buggy.

stalled as a joint venture with the Ohio Oil Company who were laying two lines across the river at the same location. The Sabine River is about 45 ft deep at its deepest point and 1200 ft wide at the crossing site. For this crossing, ⅜-in. wall pipe was used as an added safety measure.

The line was grit blasted and given a primer coat followed by hot enamel into which was wrapped glass fiber and asphalt impregnated felt, followed by heavy kraft paper. Because of higher temperature conditions, the initial 3000 ft of pipe at the Petroleum Chemicals plant was doped with cold mastic and wrapped with glass fiber mesh.

Block valves were installed at intervals along the line where they are accessible. These were installed mainly for use in case of emergency so that if a leak or line break occurs, that section can be isolated.

Scraper traps were installed on each end of the line and the line was hydrostatically tested to 1500 psi. Scrapers were pumped through the line ahead of the water in order to expell the air from the line. After the hydrostatic test, dry natural gas was connected to the line at the Petroleum Chemicals plant, a scraper was launched and the water expelled from the line by the gas. After the water was expelled dry gas continued to flow through the line to absorb the moisture left on the pipe walls. Scrapers were sent through the line at 5 to 10 mile intervals in order to spread out any water accumulation in low spots, affording the gas greater contact with the water surface for faster evaporation.

Gas was flared at the west end through an existing flare system. Tests were taken at regular intervals on the gas leaving the system to determine the moisture content. When the line was completely dry, it was shut in and considered ready for the transportation of ethylene.

Plans for Operations and Metering

Although ethylene usually is priced by the pound, actually it is transported and measured in a gaseous state. At temperatures of 50 F or above, and pressures of 750 psia or lower, ethylene is always a gas. Being a gas, it is logical that an orifice meter should be used to measure the volume of ethylene delivered and this volume then converted to equivalent pounds for the purpose of price computations.

Full standby metering facilities are provided to avoid interruption of service or unmetered service, while changing orifice plates or doing work of any kind on the instruments. Metering facilities consist of conventional orifice meter runs with flange taps and bellows-type flow meters.

Differential pressure only is recorded by the flow instrument. Static pressure is recorded by another instrument with two pens recording the same pressure on different scales on the same chart. This is done to obtain extremely accurate readings on an expanded scale, of limited range, centered on the desired metering pressure, and at the same time to provide an additional full scale reading to be used if and when pressure should be above or below the range of the expanded scale.

Temperature, for use in flow calculations, is measured by a resistance-type thermometer and recorded by an electronic type instrument.

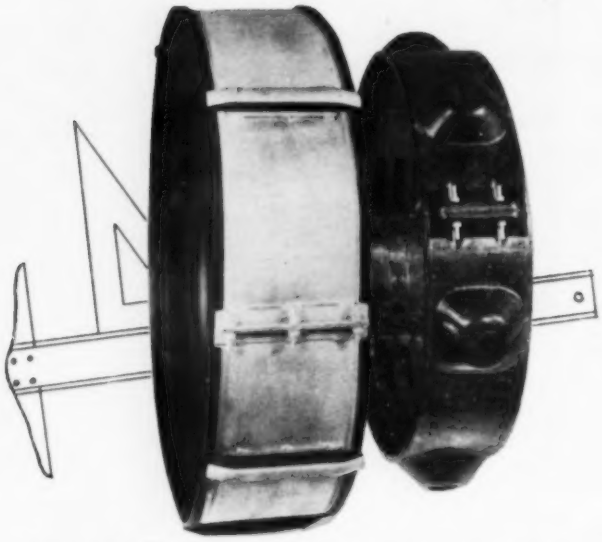
Pressure Reduction Unusual

Some unusual provisions were made for pressure reduction upstream of the metering facilities. The plant at Lake Charles will deliver ethylene into the pipeline at pressures up to 1000 psig. Deliveries will be made 30 miles away at pressures of 400 and 450 psig. Pressure drop due to friction in the pipeline is small so pressure reducing stations were provided.

Pressure reduction is accomplished in two steps: 1000 to 500 psig and 500 to 450 psig. Preliminary calculations indicated that the initial pressure reduction (1000 to 500 psig) would result in a drop in ethylene temperature from 60 F to 15 F and under these conditions ethylene gas would convert to about 60 percent liquid. To compensate for the refrigeration effect resulting from pressure reduction in both steps, heat exchangers were installed upstream of the initial pressure reduction station. These exchangers use steam as a heating medium and raise the temperature of the ethylene to 130 to 140 F so that after pressure reduction the ethylene temperature will be approximately 60 F. This eliminates any conversion to liquid and assures measurement of ethylene as a gas at the desired temperature. Desired temperature is measured with a resistance type thermometer and controlled by an electronic-pneumatic recorder-controller acting on a control valve in the steam line to the heat exchanger. The second of the pressure reductions permits much more accurate control of

COMPANY_____
ADDRESS_____
February, 1958 Void after 90 days 1

"Something From The Irishman"



TO EXCEED YOUR SPECIFICATIONS

CROSSING INSULATORS

A **Complete Line** of **Crossing Insulators, Rugged** and **Easily Installed, Maloney** Models 55, 56, and 57 encompass **All Applications. Neoprene** and **Metal** or **Molded Fiber Glass** reinforced polyester resin. **Competitively Priced,** there is a **Maloney Insulator** for **Your Specifications.**

CASING SEALS

Whether **New** or **Replacement** service is **Specified,** a **Maloney Casing Seal** will **Fill** those **Specifications** with an **Ample Margin. Slip-on** and **Zipper** types of **Tough Maloney-Compounded Neoprene** will fit a **Wide Variety of Adverse Installation Conditions.**

MANUFACTURED BY

F. H. Maloney COMPANY

HOUSTON • TULSA • LOS ANGELES • PITTSBURGH

OR YOUR Maloney DISTRIBUTOR

This tower was the control point for surveying and staking the pipeline right-of-way through 8 of the 12 miles of marsh country.

the pressure at the actual metering point.

As in the case of the orifice meter runs, full standby facilities are provided for both primary and secondary pressure reduction stations. Also provided are filters, consisting of vessels containing a granular type desiccant, for the removal of scale or other foreign material. All this equipment, as well as the orifice meter runs, is designed for operation at 1000 psig, has ring joint type flanges with soft iron gaskets, and is fully insulated.

Two different methods are used in obtaining ethylene samples for laboratory analysis. With each method gas samples are collected in stainless steel bottles. In one instance the sample bottles are filled with water and this water evacuated uniformly over a 24-hr period, using a small laboratory-type pump. Gas at metering pressure fills the void created by the evacuation of the water. In the other instance a time-schedule controller is used with a small control valve to control the pressure of the gas admitted to the sample bottles. This pressure is increased uniformly over a 24-hr period from atmospheric to approximately metering pressure.

The line from the Petroleum Chemicals, Inc., plant to the Sabine River was constructed by L. E. Farley, Inc., of Houston, Texas. The portion west of the Sabine River (about 12,000 ft) was contracted to the Bellco Engineering Company of Houston, Texas, who, in turn, subcontracted it to L. E. Farley, Inc. The Sabine River crossing was installed by Glaser Construction Company of Lafayette, Louisiana. Doping and wrapping of the pipeline was done by the Clem A. Mayes Company of Lake Charles, Louisiana. ★ ★ ★

How Pipeline Automation helps boost capacity and reduce operating costs

UNION Centralized Transport Control on various oil and gas pipelines has resulted in highly efficient operation and a material increase in pipeline capacity.

Other advantages of UNION C.T.C. are:

1. Less co-mingling of products at the interface because, with UNION C.T.C., fast-acting valves can be used and controlled quickly and accurately.

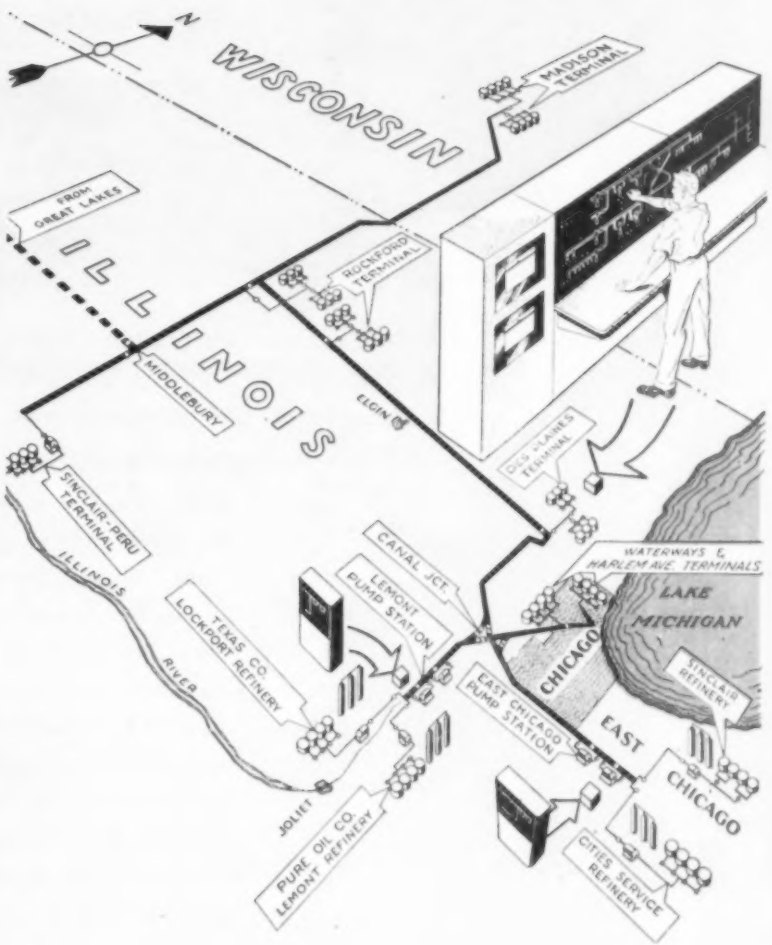
2. No false indications from interface detector because of the accuracy of the message transmitter.

3. Ability to preset movement of products through pipeline eliminates possibility of error.

4. UNION'S C.T.C. System makes it possible to tell when and where trouble is when it occurs.

The installation illustrated was the first of its type and has been in service more than two years. The reliability of the equipment permitted steady operation with little down time and low maintenance.

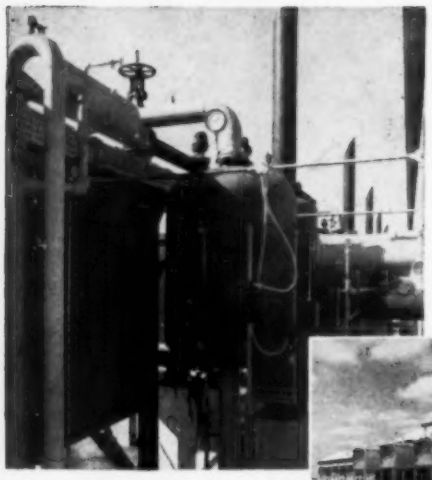
If you are planning a new pipeline, modernizing an old one, or require control for tank farms or gathering systems, let us show you what UNION Centralized Transport Control can do for you. Write for our latest Bulletin No. 1052.



Over-all plan of Badger Pipeline System. The Des Plaines dispatcher acts as the supervisor of the products flow. All information needed to control the system is contained on the UNION C.T.C. console.

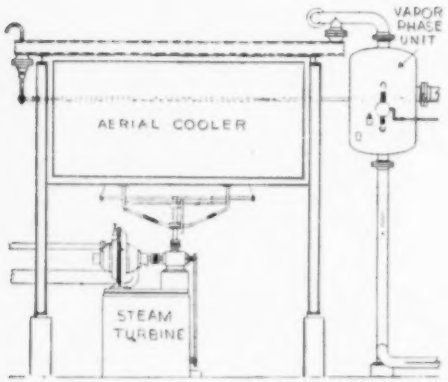
UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
PITTSBURGH 18, PENNSYLVANIA

UNITED GAS PIPE LINE CONVERTS TO VAPOR PHASE®



Eliminates Engine Power for Driving Turbine Fan... Utilizes Power Cylinder Waste Heat

In January, 1954, United Gas Pipe Line Company installed Vapor Phase Thermal Circulation on five 880-bhp gas engine compressors at their Agua Dulce, Texas, gas compressor station.



During September, 1956, one fan-drive was converted to the Vapor Phase Steam Turbine Fan Drive (utilizing power cylinder waste heat as steam at 15 p.s.i.g. pressure), thus eliminating engine power formerly required to drive the fan for lube oil cooling and steam condensing.

"Sole Developers and Manufacturers of Vapor Phase Thermal Circulation (Ebullition) Engine Cooling"

E C VAPOR PHASE

ENGINEERING CONTROLS Incorporated

AN AFFILIATE OF ST. LOUIS SHIPBUILDING & STEEL CO.

328 Paul Brown Bldg. St. Louis 1, Mo.

1939 N. Hillhurst Ave. Los Angeles 27, Calif.

Personals

Dr. B. D. Thomas, scientist and research administrator, has been named to the presidency of Battelle Memorial Institute to succeed **Dr. Clyde Williams,** whose retirement as president was announced recently. Announcement of the new appointment was made by the Institute's Board of Trustees. Active head of Battelle since being named director a year ago, Dr. Thomas has been a member of the Battelle organization for many years. He joined the staff as a research engineer in 1934, was appointed assistant director in 1942, and vice president in July 1955.

Charles A. Sweningsen has been named manager of a newly activated construction department of Southern Counties Gas Company of California. Sweningsen, formerly a construction engineer, has been with the California utility since 1947. Also promoted were **John McCollum,** as supervisor, construction procedures; and **Frank Messersmith,** as supervisor, construction quality. Both were formerly construction analysts, and both have been with Southern Counties since 1945.

Commissioner Frederick Stueck has been re-elected by the Federal Power Commission to serve as its vice chairman for another year. Commissioner Stueck has been the FPC's vice chairman since January 1, 1957, and will now serve through the calendar year 1958. He is former chairman of the Missouri Public Service Commission. He took office as a member of the FPC in July 1954 for the term expiring June 22, 1959.

K. E. Tappy, superintendent of the Ohio Oil Company's Casper (Wyoming) pipe line division for the past year, has been appointed superintendent of the Martinsville (Illinois) pipe line division. **M. L. Stanfield,** assistant superintendent at Casper, succeeds Tappy and **M. E. Parker,** acting division superintendent at Martinsville, replaces Stanfield.

Seward Abbott, previously with Servel, Inc., has been named to the Washington staff of the American Gas Association. He will serve as utilization engineer, a new position in the Washington offices, to provide information and advisory services for Federal departments and bureaus.

Robert C. Wiles has been appointed assistant comptroller of Service Pipe Line Company. Wiles has been assistant to the financial vice president, **J. L. Shoemaker** since January 1957. The new position will be in addition to the present post of assistant comptroller, held by **George F. Russell.**

Robert E. Palmer, partner in the New York firm of Reynolds & Company, Inc., has been elected to the board of directors of Williams Brothers Company, Tulsa, pipeline constructors.

Norman F. Blundell and **Sy Orlofsky** have been elected vice presidents of Gulf Interstate Gas Company, Houston, Texas. Blundell is chief engineer and Orlofsky general superintendent of the company, and both men have been with Gulf Interstate since its inception in 1953.

Personals

Carl C. Whitaker, formerly construction supervisor for Trans-Canada Pipe Lines Limited, has been appointed superintendent of operations for the company and will make his headquarters in Toronto. Whitaker will have under him operations managers in the field, construction operations, dispatching, gas measurement and cathodic protection sections.

L. P. Humann has been named head of public relations for Sinclair Pipe Line Company, Independence, Kansas. Before his promotion he was assistant superintendent of the right-of-way department.

C. Wade Cozad has been promoted to chief right-of-way agent for the Ohio Fuel Gas Company. Cozad has been with Ohio Fuel 42 years.

Willis A. Strauss has been named administrative vice president of Northern Natural Gas Company. His promotion was from director of the company's certificate department to the newly created position. In his new capacity he will assist the president in keeping in touch with and coordinating the various operations of the company. He will continue to supervise the activities of the certificate department. In addition, he will also become a member of the company's management board.

Wilson N. Gilliat has been promoted from assistant vice president-engineering, and **Charles J. Flint** from assistant chief engineer to chief engineer for Williams Brothers Company. Gilliat has been responsible for economic studies and engineering development of several gas, products and crude oil systems in the United States, Canada and South America.

After joining Williams, Flint was responsible for engineering studies, economic studies and design of turnkey pipeline projects.

Frank Ramsey has been appointed manager of Texas Gas Transmission Corporation's Wilmot, Arkansas, compressor station. He replaces **George F. Mosby,** who retired January 1.

Harold S. Walker, Jr., secretary of the American Gas Association since last February, has been named assistant to the managing director. He joined the AGA staff early in 1955 as secretary of the General Management Section.

A. B. Dilworth, M. L. Mead and Larry Shomaker have been appointed senior vice presidents of Northern Natural Gas Company.

BEST . . .
FOR
HANDLING
COATED
PIPE

THE C·R·C PIPE SLING

Made especially for pipeline use, the C·R·C Pipe Sling permits safer handling of coated pipe. The sling is rubber covered and steel reinforced. Strong, but flexible, interlocking wire links enclosed in rubber give this belt high tensile strength . . . ultimate lifting capacity is 180,000 lbs. on 36 in. pipe size sling. Yet, the sling is just ⅝ in. thick for free usage in tight ditches. Call us for more details.

MAX. PIPE SIZE	PIPE SLING DIMENSIONS	SLING WEIGHT	IRON WEIGHT	ULTIMATE LIFTING CAPACITY
36"	12' 6"x30"x⅝"	237#	103#	180,000#
30"	10'x24"x⅝"	154#	84#	144,000#
24"	8'x20"x⅝"	106#	70#	120,000#
18"	6' 3"x16"x⅝"	71#	56#	96,000#
12"	4' 6"x12"x⅝"	39#	42#	72,000#

CRC

CRUTCHER • ROLFS • CUMMINGS, INC.

HOUSTON, TEXAS
P. O. Box 2073 UNderwood 4-6391

FARMINGTON, NEW MEXICO
P. O. Box 1207 DAvis 5-5523

IN CANADA: Canadian Equipment Sales & Service Co., Ltd.
7310 99th St., Edmonton, Alberta, Canada

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Natural Gas Pipeline Company of America Finds GAS LINE LIKE NEW AFTER 27 YEARS!

Bitumastic coal-tar enameled pipe to be re-used

In relocating its line to make way for a new highway near Truro, Iowa, the Natural Gas Pipeline Company of America removed some 900 feet of Bitumastic® enameled pipe laid in 1930. According to Mr. D. C. Allen, District Superintendent, this 24-inch seamless steel tubing is in such good condition that it will be reconditioned and used again as new pipe.

Applied by the rolling and "granny-rag" method in 1930, the Bitumastic XXH Enamel on this line was in excellent condition. The asbestos-felt overwrap, originally applied loose, was torn from soil stresses, but the Bitumastic enamel coating showed no serious disbonding or deterioration. At the time of relocation, the section had been under cathodic protection for two years. Natural Gas Pipeline Company of America records show no corrosion leaks on this section during the entire 27-year period underground.

Case histories such as this from prominent pipeline companies prove the unmatched protective ability of coal-tar enamel. In these days of rising material costs, you can't afford to gamble your entire pipeline investment on a less effective coating.

Your Koppers representative will be glad to give you full information on the superior protection of Bitumastic coal-tar enamels. Koppers District Offices: Boston, Chicago, Los Angeles, New York, Pittsburgh, and Woodward (Birmingham), Alabama.

KOPPERS

BITUMASTIC
REG. U. S. PAT. OFF.
PROTECTIVE COATINGS

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Pipeline Projects

Cities Service Files To Build and Abandon

Cities Service Gas Company has asked the Federal Power Commission permission to construct and operate natural gas facilities in Kansas, and authority to abandon facilities in Texas, Oklahoma, and Kansas.

The company proposes to construct a 7000-hp compressor station in Montgomery County, Kansas; 6.37 miles of 30-in. line in Montgomery County, and 18 miles of 26-in. in Anderson and Franklin counties, Kansas.

It proposes to abandon, remove, and reclaim two 1000-hp gas compressor engines in Hemphill County, Texas; two 1000-hp gas compressor engines in Woodward County, Oklahoma; its Petrolia compressor station consisting of 6300 hp in Allen County, Kansas; its Grabham station consisting of 8450 hp in Montgomery County, and 12.74 miles of 16-in. line in Montgomery County. Some of the reclaimed compressor units would be installed in Cities Service's proposed new Grabham station.

The basic purpose of the proposed facilities, the company said, would be to make gas from its Elk City storage fields available to its markets on peak days. Deliveries from storage fields on peak days will increase from 421,698,000 cu ft in 1957-58 to 521,155,000 cu ft in 1959-60, the application stated.

Sinclair Starts Work on Teague to Houston Line

Sinclair Pipe Line Company has begun construction of the second segment of a large diameter crude oil pipeline it is building from North Texas to Houston.

The second segment, of 20-in. pipe, will run 149 miles from Teague, Texas, to Houston and is expected to be completed in June. First segment of the system was completed in April 1956, and consists of 152 miles of 18-in. from Jacksboro, Texas, to Teague.

The new line is being built to increase the company's capacity to move southern Oklahoma, North Texas, and East Texas crude into the Gulf Coast refining area. It will replace an outmoded, small diameter system.

Contract for construction of the major portion of the line, 143 miles, was awarded to Lone Star Pipe Line Constructors, Inc., of Dallas, Texas. The final six miles on the Houston end has been contracted to Golightly Construction Corporation of Houston.

Interprovincial Announces $10,000,000 Program

Interprovincial Pipe Line Company has announced a construction program for 1958 that will complete the looping of its main crude oil pipeline all the way from Edmonton to Superior, Wisconsin, to give it the equivalent of two separate lines for greatly increased flexibility of operation. Four additional units will be installed in pumping stations and a complete new pumping station will be built. The total capital investment is estimated at $10,000,000.

The loop program will consist of 82 miles of line, in four sections between 20 and 21 miles each, of 24-in. pipe to be supplied by Welland Tubes Ltd. at Welland, Ontario. They will fill in the four gaps that still exist in the 24-in. line downstream from each of four pumping stations, at Edmonton and Hardisty in Alberta, Kerrobert and Loreburn in Saskatchewan.

The additional pumping units, each of 2040 hp and diesel powered, are to be installed at the Regina and Glenavon stations in Saskatchewan and the Cromer and Glenboro stations in Manitoba. They will raise the capacity of the central and eastern portions of the main line where looping was completed last year. The new station, to be built at Bay City, Michigan, on the American section of the line between Superior and Sarnia, Ontario, operated by the subsidiary Lakehead Pipe Line Company, Inc., will be completely automatic and remotely controlled. It will be equipped with electrically driven pumps with 4400 hp, and will be the 20th station on the 1931 miles of line between Edmonton and Toronto.

The new facilities will increase throughput capacity to 275,000 bbl per day out of Edmonton, 379,000 bbl per day out of Cromer, and 261,000 bbl per day out of Superior. These figures will handle traffic in sight for the next two to three years, taking account of expansions and additions to Ontario refining capacity, which by early 1959 will be 226,500 bbl per day, and of intermediate traffic from the Westspur and South Saskatchewan pipelines between Regina-Cromer and Clearbrook, Minnesota, currently running to about 73,000 bbl per day.

The program will be financed entirely out of retained earnings.

A $4,000,000 Permit Filed With FPC

Texas Eastern Transmission Corporation and Wilcox Trend Gathering System, Inc., have asked authorization to construct natural gas facilities during 1958 at an estimated total cost of about $4,000,000, the Federal Power Commission announces.

Applications were of the budget-type, consistent with a previous policy declaration of the commission, designed to eliminate numerous small filings during 1958. The companies propose to construct and operate field facilities at a total cost not in excess of $3,000,000 for Texas Eastern and $1,000,000 for Wilcox.

Transco Lets Contract For Dehydration Plant

Transcontinental Gas Pipe Line Corporation has contracted with The Fluor Corporation for design and construction of a gas treating and dehydration plant in McMullen County, Texas.

The plant will have a capacity of 75,000,000 cu ft of gas a day and will cost in excess of $2,000,000.

Fluor has begun the engineering work and completion of the project is scheduled for July.

Southwestern Kansas Pipeline Is Approved

Jayhawk Pipe Line Corporation has been granted a permit by the Kansas Corporation Commission to construct a 242-mile crude oil line from southwestern Kansas to Valley Center near Wichita. Cost is estimated at $8,660,000.

Counties served will be Hamilton, Finney, Stanton, Grant, Haskell, Gray, Meade, Clark, Comanche, Seward, Steven, and Morton in Kansas, as well as Texas, Beaver, and Harper counties in Oklahoma.

The line will have its origin at Meade and will be constructed of 12-in. pipe to McPherson, a distance of 200 miles. From there to Valley Center it will be of 10-in.

Initial capacity will be 15,000 bbl a day; ultimate capacity 45,000 bbl.

Construction will begin the middle of April with completion scheduled for August 1.

Backer of the project are Colorado Oil and Gas Company and the National Cooperative Refinery Association. J. W. Meehan is president of Jayhawk.

YOU'RE THE
BIG
FROG
IN OUR POND!

It's better to be a BIG frog in a little pond than a LITTLE frog in a big pond.

We have no *unimportant* customers, whose orders stand by while bigger accounts get service preference. Yet we're big enough to handle any job.

Do business where your business is important. For pipe, casing, pipeline supplies, pontoons, piling, field welding . . . call on KANE . . . and get "big frog" attention — every time.

PIPE for every purpose

Convenient location for prompt delivery in the Gulf, or to any major oilfield.

KANE
BOILER WORKS, INC.
311—27th, Galveston, Texas
Phone SO3-2401 Houston: CA 2-7759

Projects

United Gas Makes a "Budget-Type" Application

An application by United Gas Pipe Line Company proposing the construction of a total of $3,000,000 in natural gas pipeline facilities has been accepted for filing by the Federal Power Commission.

United plans to build new field facilities from time to time during the calendar year 1958 to enable it to take into its main pipeline system natural gas purchased from producers in adjacent areas.

United said that the purpose of the "budget-type" application was to augment its ability to act with reasonable dispatch in contracting for and connecting new supplies of gas in producing areas generally coextensive with its system.

Permian Basin Plans Work in Andrews County

Permian Basin Pipeline Company has asked the Federal Power Commission for permission to acquire an existing 1350-hp compressor unit, located at its Andrews County station, from Phillips Petroleum Company, and operate the unit as an integral part of its system and in connection with its existing Andrews compressor facilities.

Permian also proposes to turbocharge 6 of the 12 units presently in operation at the Andrews station, which, with the new unit, would provide an increase of 4050 hp and a total installed horsepower of 20,250.

New Crude Oil Line Planned for Argentina

Yacimientos Petroliferos Fiscales (YPF), Argentina, has announced intention of constructing a 14-in. crude oil pipeline between Challaco, Neuquen Province, and Arroyo Parejas in the vicinity of Bahia Blanca port. Length of the line would be from 375 to 437 miles, depending on the route chosen.

According to the YPF announcement, the line would have a capacity of 18,600 bbl a day with one pumping station. Additions of booster stations could increase this capacity to 31,000 bbl a day.

Crude production in the Challaco-Plaza Huincil area is now 130,200 bbl a day, says YPF, which will be increased by 6200 bbl a day by wells being drilled.

At present oil from Neuquen Province is being transported by railroad.

New
TAPPING TEE
FOR GAS MAINS
by Nibco

PART NO.
4911 - GS
Made from Schedule 40 ASTM A-106 A or B carbon steel

- WELDS TO MAIN AND 1-1/4" SUPPLY LINE
- COLD-FORMED FROM SEAMLESS STEEL TUBE
- EXTRA STRONG, EXTRA SMOOTH INSIDE AND OUT
- COMPLETE WITH PLUG AND CAP

NIBCO

since 1937 manufacturers of wrot copper, carbon and alloy steel fittings

for complete information write
NIBCO INC.
Dept. H-8202 Elkhart, Indiana

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

Canadian News Notes

Trans-Canada Lets Contracts. Trans-Canada Pipe Lines, Ltd., has awarded seven contracts covering construction of the remaining 486 miles of its 30-in. natural gas pipeline, between Kapuskasing and Toronto in Ontario. The project starts at the point of termination of the Northern Ontario Pipe Line Crown Corporation 30-in. line and ends at the point where the Toronto-Montreal section of the Trans-Canada line meets the branch line from Niagara Falls, which carries United States gas into Ontario. The Toronto-Montreal line was completed early in December and is now moving American gas to delivery points where local distribution systems are in operation.

The seven contracts, with mileages and summary of terrain, are:

Spread 8, 82 miles from the east bank of the Kapuskasing River to a point near Potter, Grayco Constructors Canadian, Ltd. Shallow muskeg at west end merges into clay with heavy glacial till and loose boulders to the east.

Spread 9, 83 miles from Potter to a point southwest of Kirkland Lake, Majestic Contractors, Ltd. The entire section is in the clay belt, with glacial till and boulders.

Spread 10, 57 miles between Kirkland Lake and Rib Lake, Dutton-Williams Brothers, Ltd. Clay belt terrain occupies the north half and granite rock the south half, largely outcropping above the surface of the ground.

Spread 11, 47 miles between Rib Lake and Tilden Lake, Canadian Bechtel, Ltd. Terrain is almost entirely granite, mostly in outcrop.

Spread 12, 62 miles between Tilden Lake and South River, Morrison-Shivers, Ltd. Granite rock, mostly on the surface, at the north end merges into sandy clay and pine-covered sand soil at the south end.

Spread 13, 63 miles between South River to Bracebridge, Price-Poole (a joint venture of H. C. Price Company, Bartlesville, Oklahoma, and Poole Construction Company, Ltd., Edmonton). Sandy clay and loose boulders are found on the north portion and there is some granite at the south end. There is a large amount of casual water and small lakes.

Spread 14, 92 miles between Bracebridge and Maples, 15 miles north of Toronto, Oklahoma Pipe Line Constructors, Inc. Starting in granite rock and small lakes, the terrain progresses through sandy pine country into level and highly cultivated farm land.

Approximately 50 road and rail crossings will have to be bored on the entire line, as the right-of-way swings back and forth frequently across the Canadian National Railways and Ontario Northland Railway lines and Ontario Provincial Highways 11 and 11A. Access to all parts of the route is very easy via these all-weather blacktop highways. Pipe delivery points on the rail lines are never as much as 10 miles apart, except for one area in the south part of Spread 11 and the north part of Spread 12 where the line traverses heavy rock and lake terrain between Temagami and North Bay. This is a stretch of 60 miles with no habitation, through the Nipissing Game Preserve.

Pipe deliveries are underway. Contractors have moved in with right-of-way gangs to clear and grade as much as possible through the winter. Some winter stringing is being done also wherever the condition of the right-of-way permits.

The six major water crossings on the Trans-Canada line and three on the Northern Ontario Crown line will be awarded separately, within a few weeks.

MOLE
Pipeline
Cleaner

for BETTER cleaning of
CRUDE LINES
PRODUCT LINES
NATURAL GAS LINES

FOR DETAILS WRITE

Pipeline Cleaners Co.
Fort Madison, Iowa

Pat Mask keeps Somerville spreads "on the job"

Starting as a foreman over 20 years ago with the Somerville Construction Co., Pat has grown with us, until today he is vice president in charge of sales and the scheduling of all projects in both the United States and Canada. He is the man to call for information and action on your next job.

SOMERVILLE
CONSTRUCTION CO.
Ada, Michigan
SIGN OF SATISFACTION
TRANSMISSION LINES
DISTRIBUTION SYSTEMS

NOTICE: Specify **PELCO** Welding Saddles

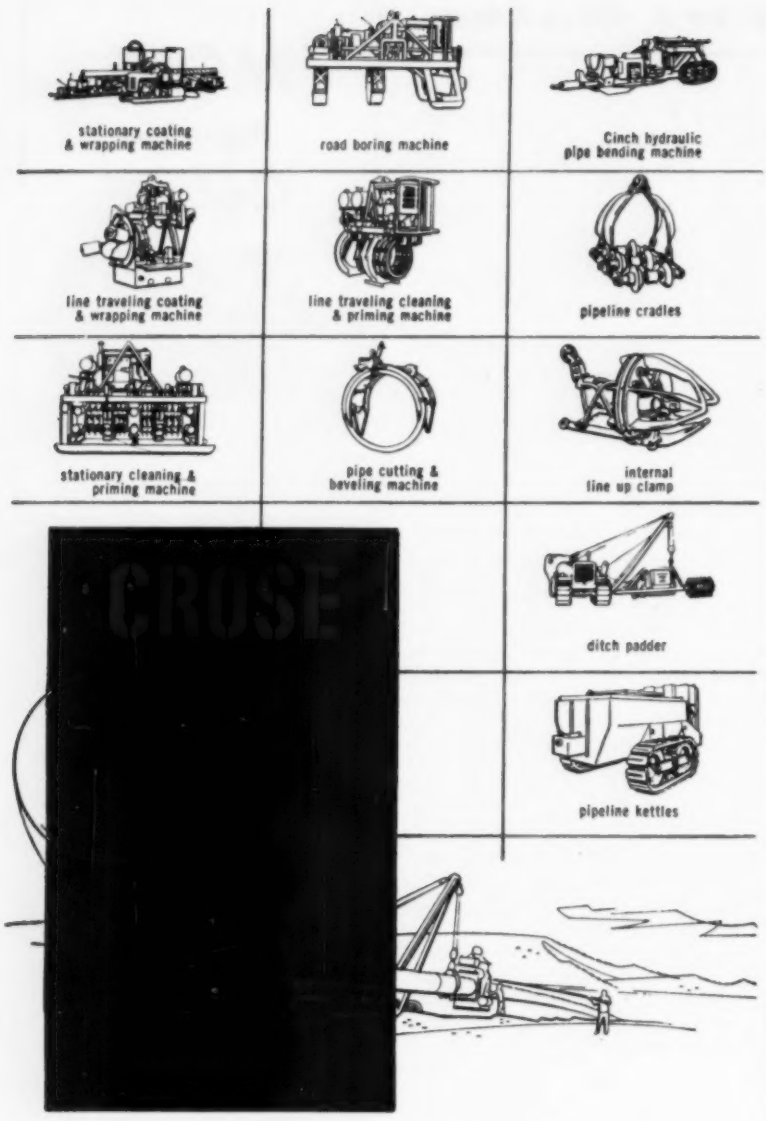
No change except the corporate name. We still have the same ownership, same management, same address, same telephone, and use the same 45 years of experience to render the same service under the same trade name — "PELCO."

PELICAN SUPPLY CO. INC.

P. O. Drawer 1108 Shreveport (84), La.
SEE YOUR NEAREST SUPPLY HOUSE

(Formerly: Pelican Well Tool & Supply Company)

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD



A COMPLETE EQUIPMENT LINE FOR PIPELINE CONSTRUCTION

The world-wide pipeline construction industry looks to Crose for the most complete line of equipment. Industry experience has proved that Crose equipment is outstanding for efficiency, operating economy — and it is always closer to work in progress because of our many strategic supply points.

New York, N. Y.
Ph. BRyant 9-2236
*Denver, Colorado
Ph. EMpire 6-0332
*Houston, Texas
Ph. MIssion 5-2484
*Newark, N. J.
Ph. MArket 4-3650
DISTRIBUTOR:
CROSE-CURRAN LTD.
*Edmonton, Alberta
Ph. 3-5135
*Winnipeg, Manitoba
Ph. SPruce 4-1851
*Warehouses in 5 locations

Crose
MANUFACTURING COMPANY, INC.
2715 Dawson Road • Tulsa, Oklahoma • Ph. MAdison 6-2171

Canadian News Notes

Carbon line construction in summer. Canadian Western Natural Gas Company, Ltd., will use its own construction crews to lay 57.6 miles of 16-in. natural gas pipeline next summer between the Carbon gas field and Calgary. The additional gas supply is to be used for peak load requirements in 1958-59 winter season. Pipe will be supplied by Stewarts & Lloyds from its mill in England.

A field gathering system to serve the six wells will consist of approximately eight miles of 6-in. to 12-in. pipe.

Topography is ideal for pipelining, as the route traverses thinly-populated gently rolling farm land, mostly range with few fences, no main highways, and only a few secondary roads. There are two large creek crossings with fairly steep banks and three others with shallow banks and approaches.

New Banister companies formed. Two new companies have been formed by the Banister organization in Edmonton following the acquisition by R. K. Banister and A. E. Helm of the interest formerly held by R. H. Fulton in Fulton-Banister, Ltd. Banister will assume control and direction of Fulton-Banister. The gas pipeline "on site" construction work formerly done by Banister Construction, Ltd., will be handled by one of the new companies, Banister-Helm, Ltd., which will do all jobs outside of actual pipelaying. Pipeline construction on main line contracts will be done by Fulton-Banister and on branch and gathering lines by Banister Construction.

The second company, Helm Equipment, Ltd., will manufacture pipeline construction equipment developed within the organization, such as the yard coating assemblies, which were first shop-fabricated in 1954 for Saskatchewan city distribution system jobs.

Trans-Mountain Throughput off. Throughput of Trans Mountain Oil Pipe Line Company will be down substantially in 1958, as forward projections indicate a market of only about 120,000 bbl per day average, compared to over 150,000 bbl per day in 1957. Principal reasons are the loss of "premium" offshore traffic to California, which averaged 22,000 bbl per day last year, reducing business in export markets on Puget Sound (quite apart from the voluntary quota system in District V), and a sharp reduction in product demand in British Columbia due to a severe industrial recession. Trans Mountain carried 80,049 bbl per day in November and 102,000 bbl per day in December. Scheduled traffic for January, according to nominations by refineries served by Trans Mountain, is 111,000 bbl per day.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

WITH THE PIPELINE CONTRACTORS

● **Fulton Banister, Ltd., 625 Northern Hardware Building, Edmonton, Alberta.** Has 100 miles of 18-in. for *Alberta Gas Trunk Line Company, Ltd.*, from Burstall at the Alberta border to Provost, Alberta. Also has 22 miles of gas gathering line in the Provost field for *Provo Gas Producers, Ltd.*, consisting of constructing gathering system and wellhead tie-ins—3 to 12-in. pipe; this gas to be fed to Alberta Gas Trunk Lines.

● **Banister Construction, Ltd., 625 Northern Hardware Bldg., Edmonton, Alberta.** Has undetermined amount of 2 to 6-in. extensions to existing systems in cities and towns in Saskatchewan, plus approximately 5000 consumer service connections, for *Saskatchewan Power Corporation*. Has contract for construction of transmission and distribution system in the town of Wilkie, Saskatchewan, for the *Saskatchewan Power Corporation*.

● **F. E. Shaw, Ltd., 530 S. Vidal Street, Sarnia, Ontario.** Has 40 miles of 6 to 10-in. line for *Dominion Natural Gas Company, Ltd.*, in the Brantford, St. Catharines, and St. Thomas districts. Has 67 miles of 6 to 20-in. transmission lines for *Union Gas Company*, Chatam, Ontario, to Dawn, London, St. Marys, Stratford, Kitchener and Guelph.

● **Williams Brothers Company, National Bank of Tulsa Bldg., Tulsa, Oklahoma.** Has 212.5 miles 20-in. crude line for *Socony Mobil Oil Company de Venezuela*. Line will extend from San Silvestre field to Puerto Cabello on the Caribbean Coast.

● **Sheehan Pipe Line Construction Company, National Bank of Tulsa Bldg., Tulsa, Oklahoma.** Has 116 miles of 8-in. line for *Buckeye Pipe Line Company* between Huntington and Griffith, Indiana; project includes take-up, reconditioning and relay. Also has 70 miles of 8-in. line to recondition for *Buckeye Pipeline Company* near Cooks Ferry, Ohio.

● **Troth Construction Company, Box 592, Britton, Oklahoma.** Has contract for 160 miles of 2 and 8-in. lines for gas distribution to communities in the Aberdeen, South Dakota, area, for *Northern Natural Gas Company*.

● **Canadian River Construction, 580 Hornby Street, Vancouver, British Columbia.** Has 150 miles of gathering lines in northern Alberta and British Columbia for *Westcoast Transmission Company, Ltd.* Also has contract on Spread Y, containing 91.3 miles of 30-in. gas line from Longlac to MP 584.8 at the east bank of the Shekak River for *Northern Ontario Pipe Line Crown Corporation*.

● **Engineers Limited Pipeline Company, 200 Bush Street, San Francisco, California.** Has line for *Pacific Gas & Electric Company* consisting of 37 miles of 20-in., 37 miles of 18-in., and 19 miles of 12-in. to lay from Beehive Bend field to Sacramento, California.

● **Williams-Austin Construction Corporation, 3322 Grant Building, Pittsburgh 19, Pennsylvania.** Has 50 miles of 10-in. for *Central Hudson Gas & Electric Company* between Kingston and Albany, New York. Also has 5.7 miles of 26-in. line for *Atlantic Seaboard Corporation* in Hardy and Grant counties, West Virginia.

● **Dutton-Williams Brothers, Ltd., North Canadian Oil Building, Calgary, Alberta.** Has 60 miles of 30-in. natural gas line from Kenora, Ontario, eastward for *Northern Ontario Pipe Line Crown Corporation*. Has 120 miles of 30-in. line for *Trans-Canada Pipe Line*. Has contract for 80 miles of gathering lines for *Westcoast Transmission Company's* natural gas grid system in the Peace River region; plans call for laying some 20-in. as an extension to the main line and also smaller diameter lines down to 6-in. for the Blueberry field.

● **Fish Service Corporation, M & M Building, Houston, Texas.** Has 67 miles of line for *Florida Pipeline and Storage Company* from Port Everglades to Homestead Air Force Base, Florida.

● **C. P. Bartley & Son Pipe Line Construction, P. O. Box 616, Tioga, North Dakota.** Has 121 miles of 2 through 12-in. gas gathering extensions for *Signal Oil & Gas Company* in the Newton, North Dakota, area.

● **Engineering-Construction Company, First National Bank Building, Tulsa, Oklahoma.** Has contract with *City of Macon, Missouri*, to lay 25 miles of 4 and 6-in. between Moberly and Macon, Missouri, and 12 miles of various size distribution lines in Macon.

● **G.E.T. Construction, Inc., 435 S. 116th St., Milwaukee, Wisconsin.** Has 46 miles of 24-in. loops in Wisconsin and Illinois for *Michigan Wisconsin Pipe Line Company*.

● **Oklahoma Pipe Line Constructors, P. O. Box 13227, Dallas 20, Texas.** Has 35 miles of 30-in. for *Tennessee Gas Transmission Company* between a point in Garrard County, Kentucky, to a point of TGT's compressor site in Powell, Kentucky. Also has 85 miles of 20 and 24-in. (spread 101) of *Trans-Canada Pipe Lines, Ltd.*, on the eastern section, in proximity of Toronto, Ontario, beginning from a point southwest of Toronto circling the city, and also a section beginning at a point east or northeast of Toronto. Also has 100 miles of 30-in. for *Creole Petroleum Corporation* between Temblador and Caripito, Venezuela. This is the company's first Venezuelan venture since 1944.

● **O. R. Burden Construction Corporation, P. O. Box 5216, Tulsa, Oklahoma.** Has 120 miles of 16-in. and 5 miles of 12-in. for *Magnolia Pipeline Company* from Midland to Abilene, Texas. Also has crossing of Neosho River at Chetopa, Kansas, for *Texaco-Cities Service Pipe Line Company*.

● **Price-Poole Pipeline Constructors of Canada (joint venture of H. C. Price of Canada Limited and Poole Construction Company, Ltd.), Rivers, Manitoba.** Has 99-mile section of 34-in. pipe to lay for *Trans-Canada Pipe Line Company* on a section of line in Manitoba Province extending eastward from the Assiniboine River near Miniota.

● **Four Way Company, Farmington Hwy., Aztec, New Mexico.** Has contract to lay 16-in. line for *Texas-New Mexico Pipeline Company*, for a distance of 150 miles southeast from the Aneth field in Southeast Utah.

● **Brown & Root, Inc., 4100 Clinton Drive, Houston, Texas.** Has contract with *Texas Eastern Transmission Corporation* to furnish field supervision for construction of 626 miles of 30-in. loops along the company's line between Beaumont, Texas, and Uniontown, Pennsylvania.

● **Holder Construction Company, Box 1438, Snyder, Texas.** Has contract on 134 miles of 6-in. products line for *Trust Pipe Line Company* between Hawley and Wichita Falls, Texas.

● **Collins Construction Company, P. O. Box 86, Port Lavaca, Texas.** Has 26 miles offshore trenching for the *CATC Group* from Grand Isle, Louisiana, to a point 26 miles out into the Gulf of Mexico. Marine Gathering Corporation is the prime contractor, and Collins is burying the line being laid by Marine Gathering's pipeline laying barge. Has dual crossing of 10-in. lines on Detroit River between Windsor, Canada, and Detroit for *Canadian Brine Ltd.* Has trenching contract for 51 miles of 12 to 26-in. lines running from shore to offshore facilities at Cameron, Louisiana, for the *CATC Group*. Also has prime contract with *Accra-Mobil Overseas Oil Company* for 11,500 ft of 12-in. sea-loading line from shore at Accra, Ghana (Africa) to a depth of 50 ft.

● **Western Pipe Line, Inc., 1011 San Jacinto, Austin 66, Texas.** Has 94 miles of 30-in. for *Northern Ontario Pipe Line Crown Corporation* between Hawk Lake and Hyndeman, Ontario.

● **Panama Inc., 1418 Melrose Blvd., Houston, Texas.** Has contract for 362 miles of 16-in. for the *Texas-New Mexico Pipeline Company* from Jal, New Mexico, northwestward. Has 193 miles of 4 to 24-in. line in Mocane and Laverne, Oklahoma, fields for *Colorado Interstate Gas Company*.

● **Vaughn and Taylor Construction Company, Inc., P. O. Box 3266, Odessa, Texas.** Has contract for 48 miles of 8, 6, and 4-in. line between Kermit and Goldsmith, Texas, for *El Paso Natural Gas Company*.

● **Mid-States Construction Company, P. O. Box 417, Mt. Vernon, Illinois.** Has contract for 50 miles of ¾ to 2-in. and 4 to 6-in. distribution and service lines in Desota, Missouri (Project 5), for *Missouri Natural Gas Company*. This work is to start March 1.

● **Mannix Company, Ltd., 332 Seventh Avenue West, Calgary, Alberta.** Has 93 miles of 30-in. for *Northern Ontario Pipe Line Crown Corporation* from a point 30 miles west of Hearst running to Kapus Kassing, Ontario. Right of way clearing is being completed and pipe laying is to begin between May 15 and June 1. Has 30 miles of 3-6-in. gathering system in Drayton Valley, Alberta area for *Pembina Pipeline Company*. This is a continuing contract with Pembina, of which 500 miles have now been completed since 1954.

SPUTNIK, MUTTNIK,
PIGnik was FIRST
... WCK Pigs Entered Outer Space in 1955
(JULY 1955 AD SHOWN BELOW)

when the moon has pipelines
they'll be cleaned with . . .
WmSON WCK-12 PIGS
THEY'RE NOTED FOR:
• SIMPLICITY OF DESIGN
• DEPENDABILITY OF PERFORMANCE
in all kinds of lines 6" through 14" sizes

T.D. Williamson, Inc.
THE PIG WITH THE POKE
CLEANS PIPE LINES
P. O. BOX 4038
TULSA 9, OKLAHOMA

WRITE FOR LITERATURE ON IMPROVED 1958 WCK PIGS

REPRESENTATIVES: HOUSTON • AMARILLO • PITTSBURGH • JOLIET, ILL. • JACKSON, MICH. • LOS ANGELES • SAN FRANCISCO • BARTLESVILLE, OKLAHOMA • SEATTLE SALT LAKE CITY • EDMONTON • TORONTO • WINNIPEG • VANCOUVER • BUENOS AIRES • CABIMAS, ZULIA, VENEZUELA • DURBAN, NATAL, S. AFRICA • PARIS, FRANCE SIDNEY, AUSTRALIA

Contractors

● **Bryans Construction Ltd., Box BL, Summerville, Toronto.** Has contract for 7 miles of 4½-in. line for *Bluewater Oil & Gas Company* between Bayfield and the Clinton RCAF Station.

● **E. K. Aldridge & Sons, Inc., P. O. Box 1324, Athens, Georgia.** Has 60 miles of ¾ to 4-in. line for *Lamar County Natural Gas Authority* (Vernon, Alabama), consisting of a 4-in. transmission line between Reform and Vernon, Alabama, and distribution systems in Vernon, Millport, and Kennedy, Alabama.

● **Lone Star Pipe Line Constructors, Inc., 10301 Shady Trail, Dallas, Texas.** Has 143 miles of 20-in. crude line between Teague and Houston, Texas, for *Sinclair Pipe Line Company*.

● **Golightly Construction Corporation, Box 15243, 6450 Liberty Road, Houston 20, Texas.** Has 6 miles of 20-in. line on the Houston end of *Sinclair Pipe Line Company's* North Texas to Houston crude line.

● **Hunsaker Trucking Contractor, Inc., 11476 Harry Hines Blvd., Dallas, Texas.** Has stringing contract for 20 miles of 16-in. between Electra and Wichita Falls, Texas, and 25 miles of 12-in. between Bellvue and Wichita Falls, both for *Lone Star Gas Company*. Has 30 miles of 12-in. to string between Sonora and El Dorado, Texas, for *Pioneer Natural Gas Company*.

● **Majestic Contractors Limited, 408 Royal Trust Building, Edmonton, Alberta.** Has contract for the 70.9 miles, 30-in. Spread X of *Northern Ontario Pipeline* between Beardmore to Longlac, Ontario. Has undetermined amount of gathering system for *Producers Pipeline Ltd.* in the Estavan, Saskatchewan, area. Has contract to lay city distribution system in Cooksville, Ontario, for *Consumer Gas Company*. Has city distribution system in Guelph, Ontario, for *Union Gas of Canada*. Has contract for testing *Trans-Canada Pipeline's* line from Alberta to Winnipeg, Manitoba.

Barney Says . . .

On springs a young man's fancy turns to thoughts of love.

* * *

The most optimistic person I ever heard of was Solomon's 500th wife.

* * *

Europe isn't the only place that has fine old ruins. Take a look around any U.S. night club.

* * *

If it wasn't for being behind, some people would never be anything.

* * *

A man that won't lie to a woman has very little consideration for her feelings.

* * *

Some guys like tall gals — others go after the little lasses.

* * *

Why do most men's ship come in after they are too old to navigate?

* * *

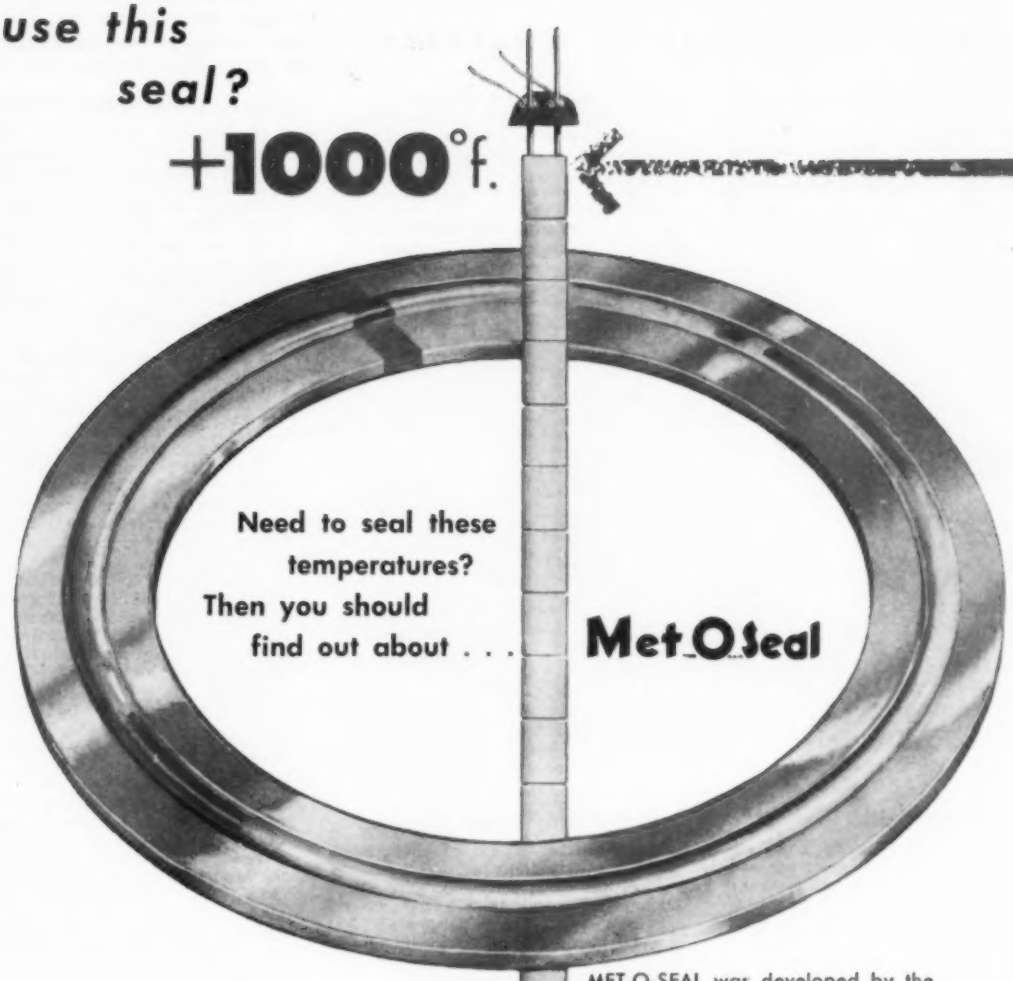
The cowboy's horse stopped suddenly. Injun trouble.

* * *

The reason a lot of women use Dial soap is because spelled backwards it sounds like pleasure.

can you use this seal?

+1000°f.



Need to seal these temperatures? Then you should find out about . . .

Met-O-Seal

MET-O-SEAL was developed by the Franklin C. Wolfe Company to provide a practical answer to no-leakage sealing at extreme temperatures. Here are just some of the advantages obtainable:

- Lower machining costs
- Less flange weight
- Can not blow out
- No loss of structural strength
- No leakage!

If you design in these temperature ranges why not find out about MET-O-SEAL, one of the proven members of the Gask-O-Seal Family?

New literature NOW available upon request. Write For Free Copy.

−400°f.

FRANKLIN C. WOLFE CO.

Culver City, California

"sealing design specialist"

A DIVISION OF Parker Hannifin CORPORATION

creative leader in fluid systems

NEW Pipeline Equipment

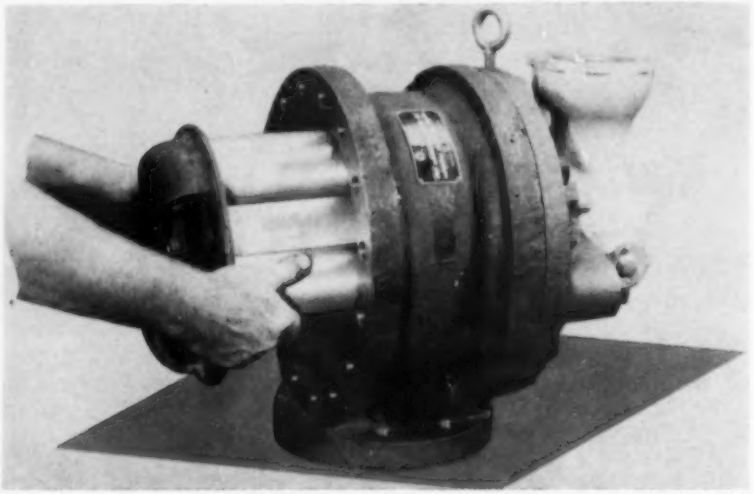
• machinery • supplies • services

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers

Crank-Control Conversion Kits

New crank-control conversion kits for old-model Rockwell Rotocycle liquid meters have been introduced by Rockwell Manufacturing Company. The kits, consisting of a complete new crank-controlled rotor measuring assembly, are designed for easy installation in all No. 4, No. 5, and No. 6 models now in the field.

Advantages claimed for the linkage-controlled assembly include: (1) 20 percent greater measurement capacity, (2) greater life expectancy, (3) quiet operation, (4) permanent timing (eliminating retiming effort and cost), (5) fewer moving parts (reducing maintenance costs). *Rockwell Manufacturing Company.*

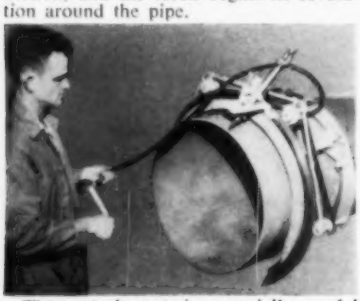


600 Rotocycle control rotor assembly is installed in a standard cast steel 600 Rotocycle meter body.

Circle number (81) on reply card.

Flexible Shaft Added

The H&M Pipe Beveling Machine Company announces the addition of the new flexible shaft to its line of accessory equipment, made to fit any size in the H&M pipe cutting and beveling machine line. The Flexible Shaft is designed to allow complete visibility of the cutting or beveling operation. It is made from a length of flexible tubing, with a crank handle attached to one end of the tubing and the other end attached to the crank pinion on the machine. As the operator turns the crank, the ring gear is put in motion, and the torch begins its revolution around the pipe.



This attachment is especially useful when cuts or bevels are being made on the larger sized pipe, where the operator has difficulty watching the cut from his normal position. With the Flexible Shaft, the operator can stand in any position and observe the cut through the full circumference of the pipe. *H&M Pipe Beveling Machine Company.*

Circle number (82) on reply card.

Expands Fire Pump Line

Expansion of its line of single-stage, double suction pumps for fire or booster service has been announced by Allis-Chalmers. New additions to the line are 6 by 5-in. units (Type KSIF) rated 1000 gpm at pressures from 60 to 100 lb, an 8 by 8-in. pump rated 2000 gpm at pressures from 60 to 100 lb, and a 10 by 8-in. unit (Type SHF) rated 2500 gpm, 100 lb pressure, 1760 rpm. Units are available in capacities of 2500 gpm, at heads to 335 ft and pressures to 145 psi with inside or outside hose headers, with or without circulating relief valve, for manual or automatic operation. *Allis-Chalmers Manufacturing Co.*

Circle number (83) on reply card.

Rotary Face Seals

A line of rotary face seals for use in difficult sealing problems involving high speed rotating shafts, is announced by Skinner Seal Company. Skinner states that this particular seal, operating from —320 F to 1200 F, will handle practically any rotating sealing problem. Because the machined bellows spring seal is a machined part without openings, leakages are impossible, it is stated. This seal, with the proper sealing face material, in combination with the bellows spring, remains stationary against the rotating shaft face. It can be had with facings of carbon, tungsten-carbide, or other suitable material, according to temperature and pressure requirements. *Skinner Seal Company.*

Circle number (84) on reply card.

Heavy Duty Rotary Pump

A vane type rotary pump, delivering more than 170 bph and operating efficiently at pressures up to 600 psi, is now offered by the Marquette Division of Curtiss-Wright Corporation. Known as the Model 2000, this positive displacement pump has been tested and approved on gathering lines in Louisiana, Texas, Oklahoma, and Kansas. The manufacturer states that it will give excellent performance in other applications where the liquid is at least as viscous as kerosine or light engine oil and inlet conditions are consistent with the characteristics of the liquid.

The Model 2000 delivers a non-pulsing flow at a rate that remains fairly constant as the outlet pressure varies. It will operate under vacuum conditions if the liquid does not vaporize. The noise level is low. Capacity of the pump can be controlled easily by changing sleeves, which takes only 20 minutes. Vanes can be replaced in 15 minutes. Only half an hour is required to replace the rotor, shaft, sleeve, seal, and bearing assembly with another assembly. All of these maintenance operations can be performed without disconnecting or moving the pump. *Marquette Division, Curtiss-Wright Corporation.*

Circle number (85) on reply card.

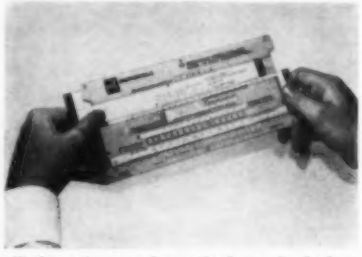
Digital Pressure Recording System

Model 5770 Digital Pressure Recording System is designed for applications such as production testing of pressure switches. In one typical production line application, the Model 5770 Digital Pressure Recording System sweeps through a pressure range of 0 to 375 psi and prints out the digital value of pressure at which the pressure switches operate. *Beckman Instruments, Inc., Systems Division.*

Circle number (86) on reply card.

Microwave System Slide Rule

Here's something of interest to communications engineers. It is a new slide rule designed by microwave engineers at Motorola, Inc. After making countless calculations of path loss, antenna gain, fade margin, carrier-to-noise ratio, and



all the other mathematical manipulations that are required for planning a microwave communications system, Motorola engineers developed the slide rule to simplify these calculations for microwave equipment users. *Motorola Communications and Electronics, Inc., Microwave and Industrial Control Department.*

Circle number (87) on reply card.

A DIVISION OF Parker Hannifin CORPORATION
creative leader in fluid systems

Small Coupling Line Expanded

Light, rugged couplings to connect small pumps, fans, and conveyors with prime movers have been added in 2 new sizes to its Model B line of Fast's couplings by Koppers Company. Model B couplings are now available in sizes No. 1 and No. 3. These 2 sizes have been added to the No. 1½, No. 2, and No. 2½ couplings that have been made for some time, thus establishing a complete line of the couplings capable of accommodating shafts from the minimum to 3⅛ in. maximum. *Metal Products Division of Koppers Company.*

Circle number (88) on reply card.

Transistor Mobile Radio Equipment

General Electric Company's Communication Products Department announces it has developed the first transistor-powered line of mobile radio equipment. A 60-w mobile unit is a feature of the new line, although the company offers 60 or 30 w transistor-powered mobile radios in low band (25-54 mc), 25 or 50

w in high band (144-174 mc), and 15w in Citizens' Band (450-470 mc). The new units may be used with either positive or negative ground 12-v d-c systems—an important consideration in fleets that include trucks. *General Electric Communication Products Department.*

Circle number (89) on reply card.

Kwik-Mix Moto Bug

Ability to carry 3000 lb in an 18 cu ft hopper or when used as a platform carrier is one of the many features incorporated in the new Kwik-Mix Moto-Bug. As a forklift (at 15 in. load center) the model will raise 1500 lb to 7 ft. Operator can tilt the forklift mast 10 deg back—2 deg forward. Carrying a full load, the Moto-Bug can climb a 25 percent grade; turn in an 84 in. radius if a forklift, 82 in. if equipped as a hopper or platform carrier. *Kwik-Mix Co., division of Koehring Company.*

Circle number (90) on reply card.

Fire-Resistant Lubricant

Savings in air compressor maintenance costs and greater safety from flash fires and explosions can be obtained with Pydraul AC, a fire-resistant synthetic lubricant for air compressors. Carbon deposits on exhaust valves and in interstage equipment are drastically reduced with the lubricant's use. By minimizing carbon deposits and resisting oxidation, Pydraul AC also serves to eliminate what are believed to be the basic causes of explosions and receiver fires in air compressor systems. The auto-ignition temperature of the fluid is greater than 1100 F. *Monsanto Chemical Company.*

Circle number (91) on reply card.

Wheel-Type Trencher

Parsons Company announces production of a new economy priced, wheel-type trencher, the crawler mounted 130. Built to dig trenches up to 5 ft, 9 in. deep, the 130 has 3 wheel speeds — 134,277 and 337 ft per min. Five digging speeds for each wheel speed, or a total of 15 speeds, permit a digging range of 12 in. to 18 ft per min. By changing the sprocket, 15 additional digging speeds are possible. *Parsons Company, Koehring Division.*

Circle number (92) on reply card.

Limit Switches

A pair of new 2-circuit limit switches that are compact in size and have high electrical capacities are available. The precision limit switches include a roller-plunger-actuated switch and a (push or in-line) plunger-actuated switch. The roller-plunger switch (designated 5LSI) which is especially effective for cam or slide operations, can be rotated 90 deg from the switch cover plate. The plunger actuated switch (designated 2LSI) offers a full ¼ in. of overtravel. Both are completely sealed and are highly resistant to abuse and wear. *Micro Switch, div. of Minneapolis-Honeywell Regulator Company.*

Circle number (93) on reply card.

Cathodic Protection Rectifier

A new model cathodic protection rectifier has been announced by Rio Engineering Company. Featured are an easy-to-change voltage tap system that requires no tools and a removable side panel that gives immediate access to all components. *Rio Engineering Company.*

Circle number (94) on reply card.

WALKER COMBINATION PREHEATER AND HEATED CENTRIFUGE

Winter is Here!

This new low-cost machine is the only economical device to make possible accurate B. S. & W. tests regardless of weather. Heat loss during test is negligible, even in coldest climate. Both 6 and 12 volt models. Install almost anywhere on gauger's car. Write for information and prices.

"Everything the Gauger needs from one dependable source."

W. L. Walker Co.

Phone: Diamond 3-8241
1009 South Main Tulsa, Okla.

Write for Bulletin

PATENTED

PIPELINE VENTS AND MARKERS

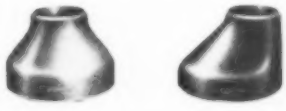
FLEET-LINE CO.
P. O. BOX 276-A
SHREVEPORT
LOUISIANA

Write for Specifications Folder

FLEET-LINE®

WELDING FITTINGS

REDUCERS: Concentric and eccentric. Nominal pipe sizes 1" to 30", ASA B16.9, ASTM A234. Schedules 10 to 160, stainless steel, and other alloys. Special lengths and sizes.



SADDLES: Conventional, and for pressure vessel heads. Nozzle sizes from ¼" to 24". Fleet Line saddles weld neatly into place in much less time, and with much less welding rod.

Complete encirclement saddles.

Fast interested service.
Write for Literature.

STEEL FORGINGS, Inc.

P. O. Box 276A • Shreveport, La.

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

NEW Literature

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers

"Golden Opportunities"

Form No. D763, an 8-page booklet released by Caterpillar Tractor, explains the services available from Caterpillar dealers in returning owners' parts to useful service. Using track assemblies as one example, this booklet graphically illustrates the rebuilding of sprockets, idlers, track links, track roller rims and flanges, roller bushings and track shoe grousers. *Caterpillar Tractor Company.*

Circle number (95) on reply card.

Welded Steel Pipe

Armco has issued a new 8-page publication on its welded steel pipe for industrial uses. Diameters range from 6 to 36 in.; wall thicknesses 9/64 to ½ in. Advantages are listed, and there are data on pressure design and dimensions and properties. *Armco Drainage & Metal Products, Inc.*

Circle number (96) on reply card.

Gas Line Filters

A series of gas filters for control of pipeline dust is described in a newly published bulletin. Also offered is a companion bulletin covering handling of liquid-gas separation in the line. Both pieces are illustrated to give basic construction and diagrammatic operation of each unit. *Perry Equipment Corporation.*

Circle number (97) on reply card.

Clamshell Specifications

A new, 2-color specification bulletin describes the Schield Bantam Company's line of clamshell buckets. Included are complete specifications and job action photos of both the general purpose ⅜ yd and special ½ yd rehandling buckets. Important features include large 10-in. head and lower sheaves to increase cable life, all steel head fabricated to give extra support to rigid arms, and extra large hinge pins allow scoops to move freely. *Schield Bantam Company.*

Circle number (98) on reply card.

Results of Pipe Wrap Tests

A new 6-page product folder of special interest to the pipeline industry has been published by L. O. F. Glass Fibers Company. The illustrated brochure features Blue Flag Pipe Wrap, the company's glass reinforcement for pipe enamel coatings. In addition to product data, are findings of recent performance tests conducted by the U. S. Bureau of Reclamation. *L. O. F. Glass Fibers Company.*

Circle number (99) on reply card.

High-Speed Synchronous Motors

Features and applications of General Electric's large high-speed synchronous motors, and the company services that go with them, are described in an 8-page bulletin. Photographs illustrate the designing and manufacturing facilities of the company's large motor and generator department. Large cutaway drawings give an X-ray view of the horizontal and vertical motors of 1500 hp and up. *General Electric Company.*

Circle number (100) on reply card.

Heavy-Duty Excavator

A new 4-page bulletin on the crawler mounted 805 Excavator, recently placed into production by Koehring Division, is available. Used as a 2 cu yd shovel, 2 to 3 cu yd dragline or clamshell, or a 52-ton lift crane, the 805 was designed to fill a production gap on construction and material handling jobs. *Koehring Company.*

Circle number (101) on reply card.

Axial Compressors

Design and construction features of Allis-Chalmers axial compressors available in sizes from 8000 to 1,000,000 cfm are described in a new bulletin. Among the features of the axial compressor is its basically constant volume with variable pressure output; high efficiency, compact, streamlined design; flexibility, and virtually trouble-free operation. *Allis-Chalmers Manufacturing Co.*

Circle number (102) on reply card.

Welding Supplies and Accessories

A new 48-page catalog on supplies and accessories for gas and arc welding is available from Air Reduction. Presented in this catalog, which contains over 100 illustrations, is complete information on ferrous and non-ferrous welding rods for oxyacetylene welding and Heliwelding; welding and brazing fluxes and their applications; aluminum welding fluxes; Aircosil silver brazing alloys; brazing alloys; Jackson and Airco protective equipment including goggles, glare protection spectacles, cap and goggle combinations, welding helmets and face shields, hard hats, headgear and pocket shields; leather welding gloves; Jackson electrode holders and cable connectors; weld cleaning tools; twin and single line hoses, and many other items. *Air Reduction Sales Company.*

Circle number (103) on reply card.

Pumps, Compressors, Specialities

Machinery and equipment used in pipeline operations are described in a catalog issued by Oil Well Supply. Included are pumps, compressors, and specialty items. Specifications and performance data on many types of pumps are given. *Oil Well Supply.*

Circle number (104) on reply card.

Tractor Maintenance

A new Maintenance Guide for Caterpillar D2, D4, and D6 tractors has been prepared especially for operators. Its primary purpose is to supplement the more detailed information found in Caterpillar "Operation And Maintenance" books. The Maintenance Guide is filled with more than 80 full color drawings, illustrating helpful service tips. Written in narrative form, the 24-page booklet tells how 1 machine owner improved the performance and longevity of his tractor through good maintenance methods. *Caterpillar Tractor Company.*

Circle number (105) on reply card.

Silencing the Gas Turbine

How the tremendous noise of a gas turbine engine can be effectively silenced for the first time is explained in a 12-page brochure recently published by the Industrial Sound Control Department of Koppers Company, Inc. The detailed brochure outlines 10 easy steps that will enable a gas turbine engineer to determine quickly what type of sound control unit is necessary to silence his turbine. This is possible, the company says, because Koppers gas turbine silencers are standardized and because the range of types and sizes are applicable to a wide variety of conditions.

Included in the brochure are pictures and drawings of 2 typical types of Koppers gas turbine silencers. One shows the use of Soundmetal panels of special design and the other employs the unique Soundstream principle which achieves broad band frequency control. *Industrial Sound Control Department, Koppers Company, Inc., Metal Products Division.*

Circle number (106) on reply card.

All-Wheel Drive Trucks

An 8-page, full-color catalog describing and illustrating 6 heavy-duty International all-wheel-drive truck models of cab-forward design has been issued by the motor truck division of International Harvester. Included are 4-wheel-drive International models AC-170(4x4) and AC-180(4x4) with GVW ratings of 18,000 and 20,000 lb, respectively, and 4 6-wheel-drive International models in the ACF-170(6x6) and ACF-180 (6x6) series with GVW ratings from 22,000 to 33,000 lb. All units described in the catalog are available with either gasoline or LPG engines. *International Harvester Company.*

Circle number (107) on reply card.

Twin Arc-Welder

Opening the door to higher profits through use of a Cat Twin Arc-Welder is a new 8-page, 2-color booklet, "Seven Keys to Welding Profit," released by Caterpillar Tractor. Pointing out the 7 key factors making use of welders profitable, the booklet stresses: Reliable Caterpillar power, 2 steady arcs, dual controls, parallel power, diesel economy, portability, and Caterpillar dealer service. *Caterpillar Tractor Co.*

Circle number (108) on reply card.

Pipewall Thickness Gage

A bulletin on portable pipewall thickness gages describes the operation of this lightweight (7½ lb), nondestructive method determining the extent of corrosion, erosion, or scalp buildup on pipe walls. *Industrial Nucleonics Corporation.*

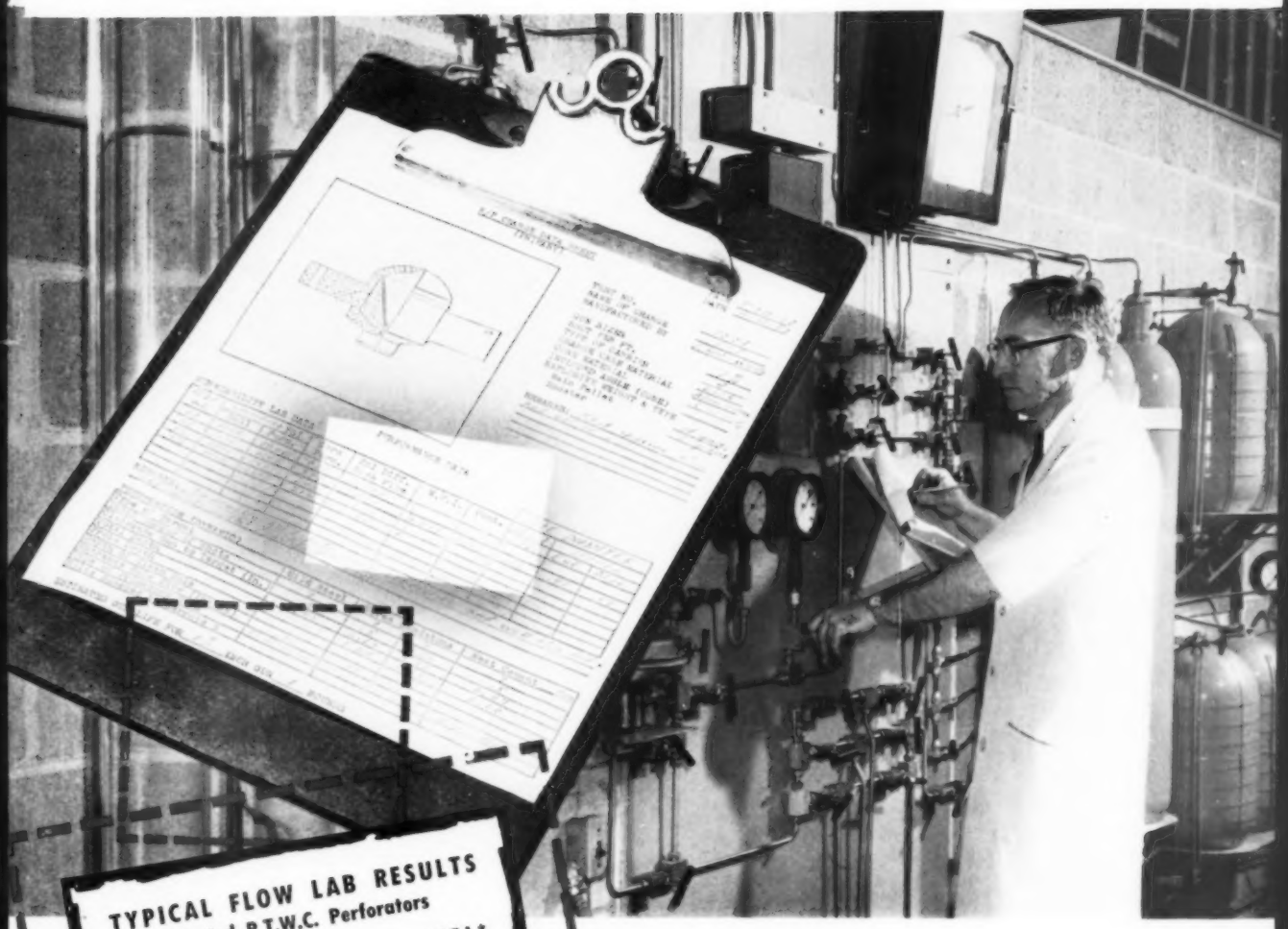
Circle number (109) on reply card.

Killing Weeds Chemically

Weeds and brush along pipeline rights-of-way and on industrial sites such as tank farms can be cleared chemically at a cost averaging ⅓ below that of hand or mechanical cutting.

The 24-page booklet by Monsanto Chemical Company points out that various formulations of 2,4-D and 2,4,5-T and mixtures of these chemicals now make possible year-round programs of foliage, basal and stump spraying for maximum weed and brush control at substantial long-term savings of time and money. *Monsanto Chemical Co.*

Circle number (110) on reply card.



TYPICAL FLOW LAB RESULTS
Selected P.T.W.C. Perforators

Perforators	Average W.F.I.*
1 11/16 Bearcat	1.13
2 3/16 Bearcat	1.06
1 11/16 Swing Jet	.96
1 11/16 Competitor A	.92

*Well Flow Index is the ratio of the flow through the perforated core to the flow through the same core prior to perforating.

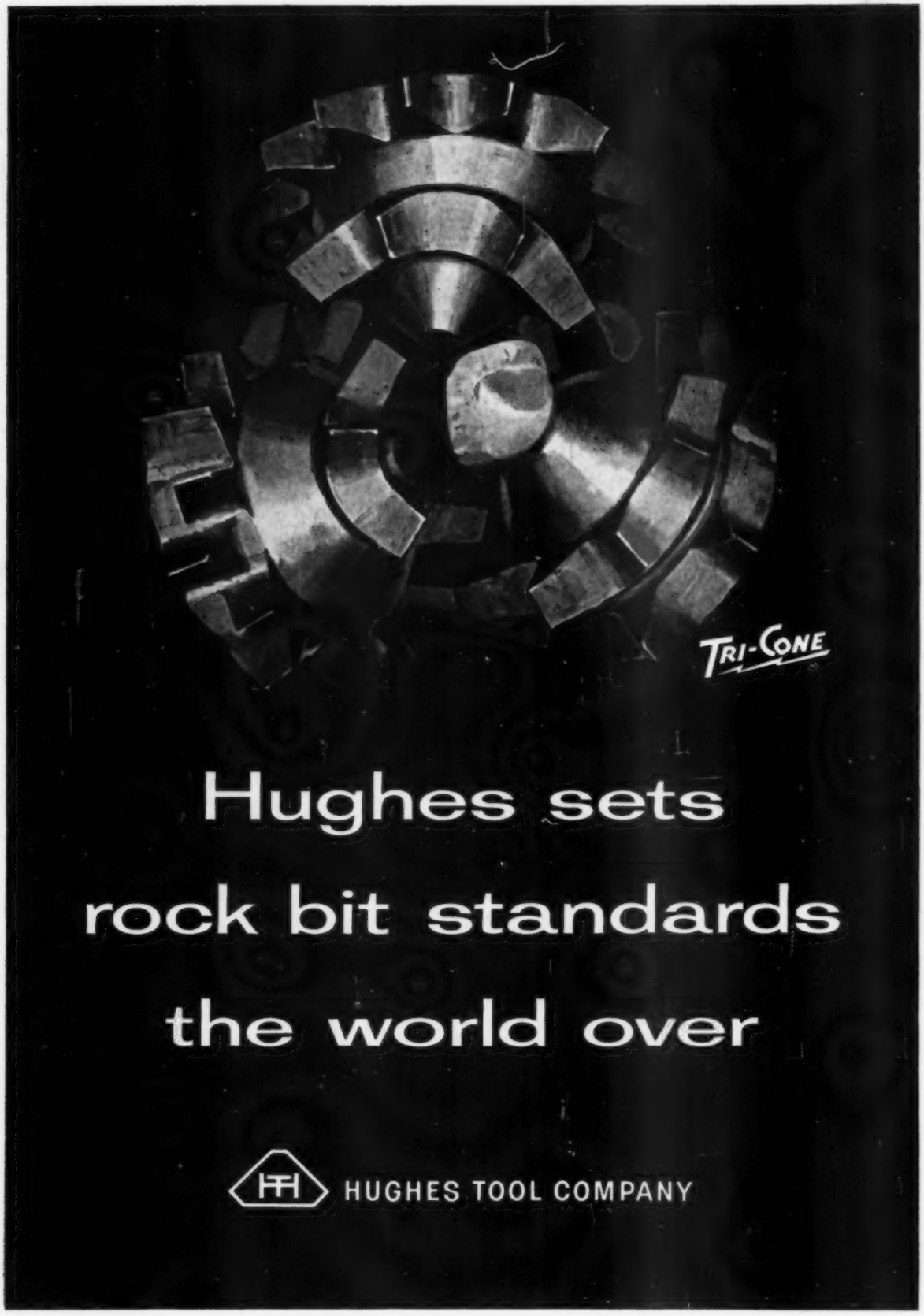
Documented PERFORATING PERFORMANCE

FROM THE LABORATORIES OF LANE-WELLS COMES A NEW MEASURE OF PERFORATING EFFECTIVENESS

For more than a year Lane-Wells Flow Laboratory engineers have been testing perforators under pressure and temperature conditions duplicating those found underground . . . accumulating data to help you evaluate perforating. Perforations made under various formation-to-hole pressure differentials in formation samples and the subsequent flow rates provide an index of perforating effectiveness. This WFI (well flow index), together with other accepted perforating performance values, gives you more information than has ever been available before. Ask your Lane-Wells man about this newest Lane-Wells research contribution in the interest of improved petroleum production.

LANE-WELLS COMPANY

P. O. BOX 1664, HOUSTON 1, TEXAS



Hughes sets rock bit standards the world over

HUGHES TOOL COMPANY